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Monitoring of the closed Brampton Street Landfill

Gartner Lee

1998 Monitoring of the Closed Brampton Street Landfill

Prepared For:
Regional Municipality of Hamilton Wentworth

Prepared By:
Gartner Lee Limited

GLL 98-216

May, 1999

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May 26, 1999 GLL 98-216

Mr. Phil Jensen
Supervisor, Non Regulatory Environmental Management
Waste Management Division
Regional Municipality of Hamilton Wentworth
35 King Street East, 4th Floor
Hamilton Ontario
L8N 4A9

Dear Mr. Jensen:

Re: 1998 Monitoring of the Closed Brampton Street Landfill

We are pleased to provide our report on the 1998 monitoring at the closed Brampton Street Landfill. This is the follow-up report to the 1996/1997 Monitoring Report which determined that the landfill impacts to Redhill Creek and the nearby residential areas were minimal.

The 1998 monitoring program was outlined in the 1996/1997 monitoring report. The report presents the results of the surface water, leachate and gas monitoring which were conducted by the Region of Hamilton Wentworth staff in 1998. The main conclusions and recommendation in this report are:

a) the landfill is not causing a significant impact on Redhill Creek and leachate collection would not significantly improve water quality in the creek;
b) landfill gas generated in the landfill is not migrating towards the residential area southeast of the site. Therefore, gas control measures are not required; and
c) long term monitoring of gas, leachate and surface water quality is recommended to confirm these conclusions.

We trust that this report meets your needs. If you have any questions, please contact the undersigned.

Yours very truly,
GARTNER LEE LIMITED

Heather Malcolmson, M.Sc.
Senior Hydrogeologist
Project Manager

HM:mm / Attach.

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1. Introduction

1.1 Background

The former Brampton Street Landfill is located near the north end of the City of Hamilton. The site is situated about 150 m southwest of Queen Elizabeth Way and bounded by Redhill Creek on the north and east, Brampton Street on the south and to the west, by the Region owned Woodward Avenue Sewage Treatment Plant. A Hamilton Public works yard is located just south of the site and is constructed on fill materials.

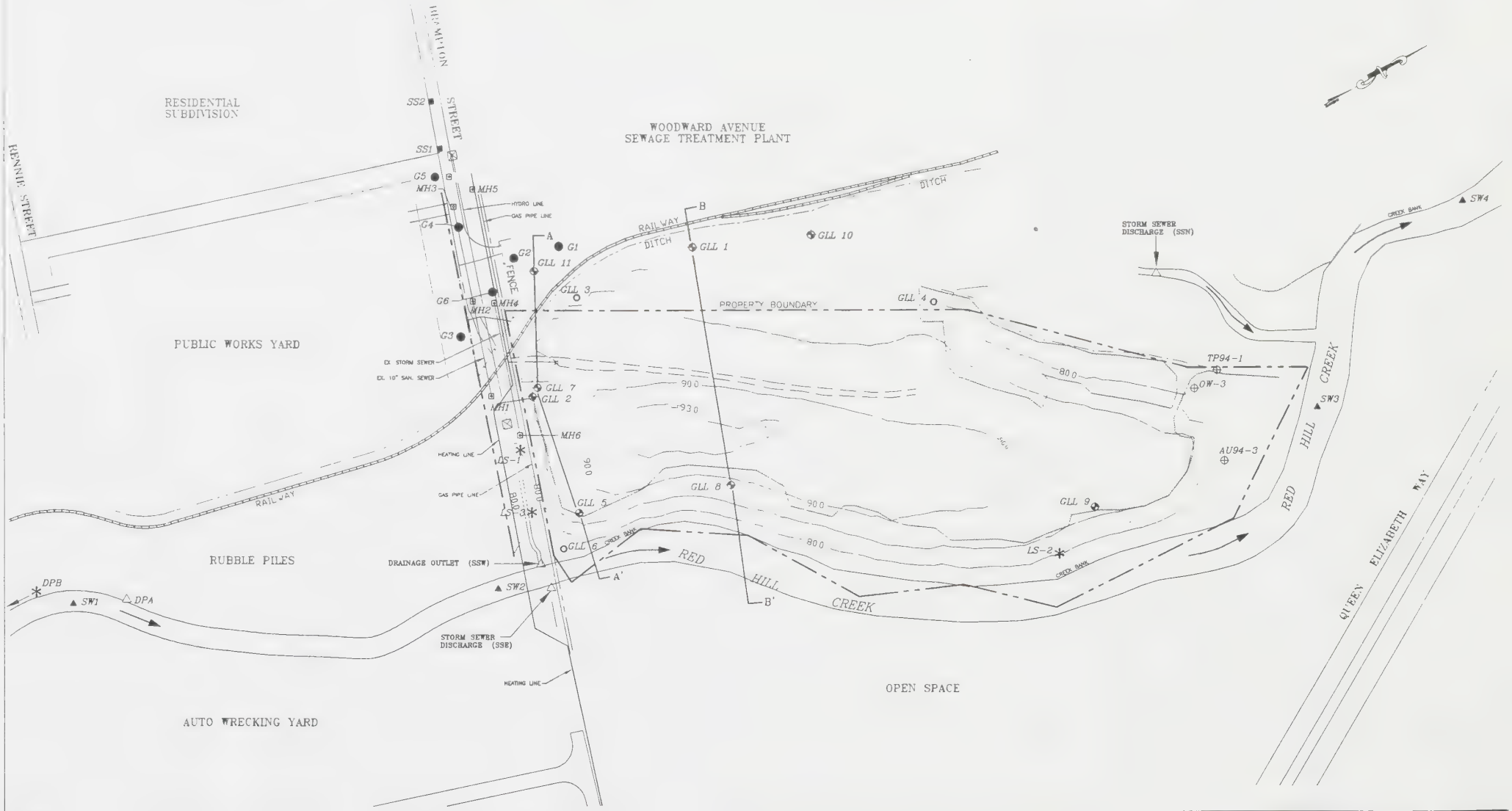
The landfill is approximately 7.5 ha in size and contains up to about 15 m of waste. The site was operated by the City of Hamilton during the 1950s and 1960s and reportedly used for the disposal of municipal and industrial waste from the Hamilton area. The site was closed in 1974.

As shown on Figure 1, a number of buried utilities are present just south of the landfill. A shallow storm sewer runs east west along Brampton Street and discharges into a gully south of the site. The exact location of this storm sewer outlet could not be found in the field. A deeper sanitary sewer runs from west to east along Brampton street, discharging to the sewage treatment plant. There is also an abandoned chlorine gas pipeline running east west along Brampton Street which crosses Redhill Creek. More recently (summer 1997), a steam line was constructed along Brampton Street, crossing under Redhill Creek. Also during 1997, a public walkway was constructed across Redhill Creek, along the south boundary of the landfill and in through the public works yard (south of the site). Some regrading of the ground surface occurred during this construction and the construction of the steam line.

Since 1980, several studies have been completed at the site with respect to waste characterization and the potential impact of the landfill on Redhill Creek. These studies found registrable non-hazardous waste present in the landfill. As a result of these investigations, a site rehabilitation program was implemented including topsoil placement and seeding for erosion control.

The monitoring program for surface water quality in Redhill Creek has been conducted annually by the Region of Hamilton-Wentworth since 1984. In 1991, in response to local concerns about leachate breakouts along the southwest toe of the landfill, a leachate collection sump was constructed in the fill. Leachate was removed from the sump through pumping and treatment at the adjacent sewage treatment plant. For health and safety reasons, the sump was backfilled with granular material after the base of the sump was connected to the Regional sanitary sewer in 1994.

In July 1994, the Region retained Jagger Hims Limited (JHL) to assess the need for a leachate management system at the site and to propose a conceptual design for such a system if required. As a result of the study, JHL recommended that the following components be included in the concept to



LEGEND

- ▲ SW1 – SURFACE WATER MONITORING/ BENTHIC INVERTEBRATE SAMPLING STATION
- △ SSE – MONITORING STATION AT STORM SEWER DISHCHARGE
- ⊕ GLL 8 – EXISTING MONITORING WELL INSTALLED BY GLL
- o GLL 3 – BOREHOLE DRILLED IN 1995 WITHOUT INSTALLATION OF MONITOR
- ⊕ OW3 – EXISTING MONITORING WELL INSTALLED BY OTHER CONSULTANTS
- ✱ LS-1 – APPROXIMATE LOCATION OF GROUND WATER SEEP
- ● G5 – SHALLOW GAS MONITOR
- ▣ MH2 – SEWER GAS MONITORING LOCATION
- → – SURFACE WATER FLOW DIRECTION
- 900 – TOPOGRAPHIC CONTOURS (mASL)
- ~~~ – TREELINE
- A A' – GEOLOGICAL CROSS SECTION

No	Description	Date	By

Revisions

1:2500

Scales

Designed By:	Y.S.	Drawn By:	J.G.L.
Checked By:		Approved By:	
Date Issued:	APRIL 1999	Project No.	98-216
Site Name:		File Name:	98216FD1.DWG

FORMER BRAMPTON STREET LANDFILL SITE
HAMILTON WENTWORTH

SITE PLAN AND MONITORING LOCATIONS

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FIGURE 1

address the short-term impacts: a passive gas venting system; internal hydraulic connector trenches; and a toe drain to be located around the south and west perimeters of this site, with potential for future expansion to include the north and east perimeters.

In the fall of 1995, Gartner Lee Limited (GLL) was retained by the Region to prepare a detailed design for a leachate collection and gas venting system for the landfill site based on the remedial concept presented by JHL during the 1994 study. After reviewing the data from the drilling investigations and detailed topographic survey intended to support the final design work, Gartner Lee Limited identified that installation of the proposed controls would be significantly more complex than previously envisaged. The associated cost would be increased correspondingly by more than 50% compared to the original figure estimated by JHL. Gartner Lee Limited also expressed concerns with the level of information collected, regarding any actual impacts that may be occurring, and the need to install the proposed remediation. GLL therefore recommended that the Region re-evaluate the need for the proposed remediation prior to proceeding with further design and implementation work. In December of 1995, the Region requested GLL develop an appropriate monitoring program to address this issue. A monitoring program was submitted to the Region in January 1996. This program was reviewed by the Region and the Ministry of the Environment (MOE) and a revised program was presented in a letter dated May 21, 1996. The monitoring program was implemented in May 1996.

The site was monitored under the new monitoring program between May 1996 and April 1997. The Region technical staff conducted the field work and all data collected were submitted to Gartner Lee Limited for interpretation and compilation. In January of 1998, Gartner Lee Limited issued a monitoring report covering the May 1996 to April 1997 period. The report concluded that: the landfill was not adversely impacting Redhill Creek; and that landfill gas was not migrating to the nearby residential area. Based on the results, the construction of the proposed leachate collection system and gas venting system were not recommended as they would not significantly improve the surrounding environment. The report recommended continued leachate, surface water and gas monitoring with minor modifications to the previous program.

The 1996/1997 report also recommended that the exposed leachate seeps, located in the drainage ditch south of the site and along the east slope of the landfill, be remediated to mitigate aesthetic impact and prevent human/animal exposure to these seeps. To accomplish this, the ditch and seeps near LS-1 and LS-3 (Figure 1) were excavated, covered with rip-rap and then seeded. At location LS-2 (Figure 1), the area was excavated and filled with rip rap. Leachate continues to discharge in these areas, but there is no longer a concern for public/animal contact with the leachate and the aesthetic impact has been remediated. The remediation of the leachate seeps has been documented under separate cover (GLL, 1998b).

During spring 1998, the Region noted leachate seepage near the leachate collection sump located at the northwest corner of the site. The Region cleaned the sump connection to the sanitary sewer, which

eliminated the leachate seepage in this area. In May 1998, Gartner Lee Limited removed the surface soil contamination that resulted from the leachate seepage. This is reported under separate cover (GLL 1998b).

The current report presents the data collected in 1998 and the findings derived from the 1998 monitoring program.

1.2 Study Objectives

The objectives of this proposed monitoring program were as follows:

a) to establish a database with respect to surface water, leachate and landfill gas;

b) to re-evaluate the impacts of the landfill on Redhill Creek and nearby residential areas based on another year of monitoring; and

c) re-evaluate the need for landfill leachate containment and the need for gas control measures.

2. Methodology

The annual monitoring program is summarized on Table 1 and discussed in detail in the following sections. The monitoring program was presented in the 1996/1997 Monitoring Report for the Closed landfill site.

Table 1. 1998 Monitoring Program

Stations	Filtered/ Unfiltered	Frequency	Parameter List
SW1, SW2, SW3, SW4, SSW, SSE, SSN, LS1, LS3 LS2 if flowing	unfiltered	• 4 x per year (winter, spring, summer, and fall)	• Field conductivity, pH, flow, water temperature • Alkalinity, phenolics, TSS, TKN, ammonia, nitrate, nitrite, total P, chloride, • Metals (Ag, Al, B, Ba, Be, Ca, Cd, Cr, Co, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sr, V, Zn) to PWQOs
SW1, SW2, SW3, SW4, and SSW	filtered	• 4 x per year (winter, spring, summer, and fall)	• Filtered metals (see metals list above)

Stations	Filtered/ Unfiltered	Frequency	Parameter List
GLL9	filtered (except organics)	• 4 x/year as above	• pH, conductivity, alkalinity, COD, DOC, phenolics, TKN, ammonia, nitrate, nitrite, total P, chloride, sulphate, • Metals (see list above) to PWQOs
		• 2 x/year spring and summer	• VOCs (MISA 16, 17)
All groundwater and gas monitoring wells		• 4 x/year during sampling event	• Water level measurements
Landfill Gas Monitors		• biweekly in winter • monthly during other seasons	• combustible gas measurements

2.1 Leachate and Surface Water Monitoring

2.1.1 Sampling Location

Surface Water

A total of four surface water stations (SW1, SW2, SW3 and SW4) and three discharge points to surface water (SSW, SSE, SSN) are included in the monitoring program. SW1 to SW4 are the sampling points in Redhill Creek. As shown in Figure 1, SW1 is located immediately upstream of the adjacent public works yard and about 320 m upstream of the landfill. SW2, located immediately upstream of the landfill, and is considered the background station for the landfill impact assessment. SW3 is located immediately downgradient of the landfill. SW4 is about 170 m further downstream from SW3.

SSW is the discharge point located on the west bank of the creek at the drainage outlet of the gully along the south perimeter of the landfill. SSW was reconstructed in 1998 as part of the seep remediation program (GLL, 1998b). As a result, the exact sampling location for SSW changed slightly in May 1998 but it still monitors the discharge from this area. SSE and SSN are stormwater discharge points to the creek. As a storm sewer outfall, SSE is located across the creek from SSW. Both SSW and SSE are located about 30 m downstream of SW2. SSN discharges to a small tributary of the creek to the north of the landfill. The location of these stations is shown in Figure 1.

Leachate/Groundwater

Water levels were measured at all existing groundwater monitors and gas monitors at the site. The location of these installations is shown in Figure 1. The borehole logs for the groundwater monitors are included in Appendix A.

The purpose of the leachate/groundwater monitoring program is to establish leachate concentrations for the landfill and determine the potential for off-site migration of the leachate. The leachate sampling locations include one monitoring well GLL-9, and two leachate seeps LS-1 and LS-3. Monitor GLL 9, installed in the fill to a depth of about 13 m, is located at the top of the creek bank near the northeast edge of the landfill. This monitor was used to measure leachate quality in the landfill. With the remediation of LS-1 and LS-3, in May 1998, the seeps were no longer accessible and could not be sampled. Historical monitoring confirmed that, under dry conditions, the discharge at SSW is representative of a mixture of the leachate seeps, stormwater and some clean groundwater. It represents the actual quality of the leachate seepage into the creek.

As part of the leachate monitoring program, the slope of the landfill was checked during the spring, summer and fall for other leachate seeps. The only significant seepage noted was at the previously identified seep LS-2. There was insufficient flow at LS-2 to collect a sample. In May 1998, this seep was also remediated to prevent human and animal contact with the leachate. With the remediation, the seep is not accessible for sampling.

2.1.2 Sampling Schedule

The sampling was carried out by the Region technical staff based on Table 1, with GLL staff providing support when requested. Since the last monitoring report, surface water sampling was conducted on July 7, 1997, and February 19, May 6, July 17/23 and October 7/8, 1998. These represent summer 1997 and winter, spring, summer and fall 1998 monitoring events, respectively. This surface and groundwater monitoring program covered both dry and wet seasons throughout a normal year. The four surface water stations and three discharge points were sampled on the same day during all but the July monitoring event. During July, SW3 was sampled on a different day than the other locations.

Leachate samples were collected from monitor GLL9 on July 7, 1997 and February 19, May 6, July 23 and October 7, 1998. Leachate seeps LS1 and LS3 were only sampled on the July 1997 and February and May 1998 sampling events as the seeps are no longer accessible (discussed above).

Additional sampling beyond the required schedule took place on October 8, 1998 at stations SW3, SW4, SSW and SSE. These stations were resampled after oily water from SSE was observed to discharge to the creek during the previous sampling. This discharge is unrelated to the landfill since it discharges from the opposite side of Redhill Creek. The follow-up sampling was conducted to ensure a sample was collected without obvious outside influences.

2.1.3 Analytical Parameter

Surface water and leachate samples were analyzed for water quality parameters outlined on Table 1. These included a total of 16 general water quality parameters and 18 trace metals. To address the source of elevated iron concentrations (and other sediment related metals) in the creek, filtered metals samples were also collected from SW1, SW2, SW3, SW4 and SSW for analysis.

Samples collected from leachate monitor GLL9 during the May, July and October 1998 sampling events were also analyzed for MISA analytical groups 16, 17 and 19. The organics analyzed for included 33 volatile organic compounds (MISA Group #16 and #17) and 39 base/neutral extractable organics (MISA Group #19). MISA group analysis of the surface water stations was dropped for the 1998 monitoring program since organics were not detected in the surface water in the past monitoring programs. The organics detected in the leachate do not persist in a surface water setting. The leachate monitor GLL-9 was monitored for organics to confirm if the leachate signature was changing and determine if organics analysis is required in the surface water samples.

The sample analyses were completed by the Regional Laboratory except DOC and boron which were performed by Philip Laboratories (formerly Zenon) in Burlington, Ontario. All water quality data collected during this monitoring program are presented in the form of tables in Appendix B (for groundwater and leachate) and Appendix C (for surface water) along with historical data.

2.1.4 Quality Assurance

The field program was carried out by the Regional Environment Department. The field sampling protocols, as specified in our letter dated July 9, 1996 for both surface and groundwater monitoring, were followed by the Region's field technicians during each monitoring event. For QA/QC purposes, one field duplicate from surface water station SW1 was collected during the February monitoring event for analysis for the same parameters as performed for other surface water samples. The data show that the analysis results for both the sample and duplicate are within acceptable limits.

2.2 Gas Monitoring

Methane gas is a biodegradation product of organic waste in the landfill or organic matter in subsurface soils. Existing sanitary sewers may also be a source of methane. Concentrated methane gas is combustible or even explosive when it mixes with air. Since a residential subdivision is located approximately 150 m southwest of the landfill limit (Figure 1), a gas monitoring program was put in place to ensure there was no public health risk.

Methane gas can migrate directly through soils and migrate along underground conduits. A number of subsurface utilities exist in the area between the landfill and the subdivision within the Brampton St. road allowance which could potentially act as conduits. These include an abandoned chlorine gas line, a water main, a sanitary sewer, a storm sewer and a recently constructed heating line.

To monitor for gas migration a total of six gas monitors (G1 to G6), five manholes (MH1 to MH5) and two storm sewers (SS1 and SS2) were included in the 1998 gas monitoring program. As shown in

Figure 1, most of these monitoring points are located within or in the vicinity of the Brampton St. road allowance. By monitoring these stations, the program ensures general soil migration, as well as potential conduits are checked. The Regional field technicians conducted the gas monitoring at the site with guidance from GLL staff. A total of 17 gas monitoring events took place during the 1998 monitoring program. The monitoring frequency was biweekly in the winter and spring and dropped to monthly in the summer and fall of 1998 at these locations. The combustible gas monitoring data are presented in Appendix D.

3. Site Physical Conditions

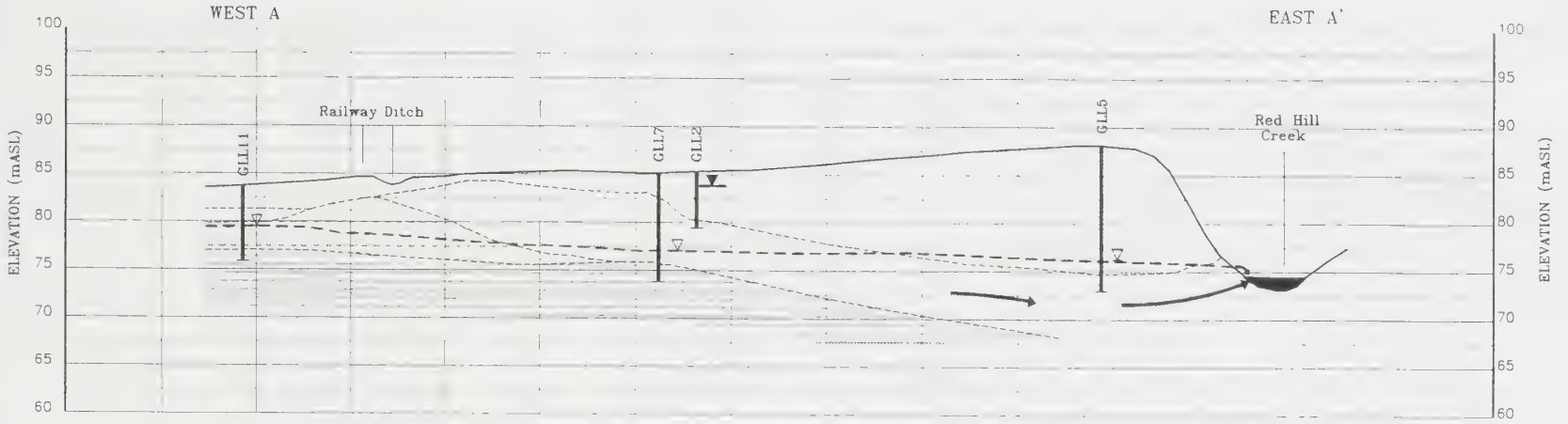
3.1 Topography

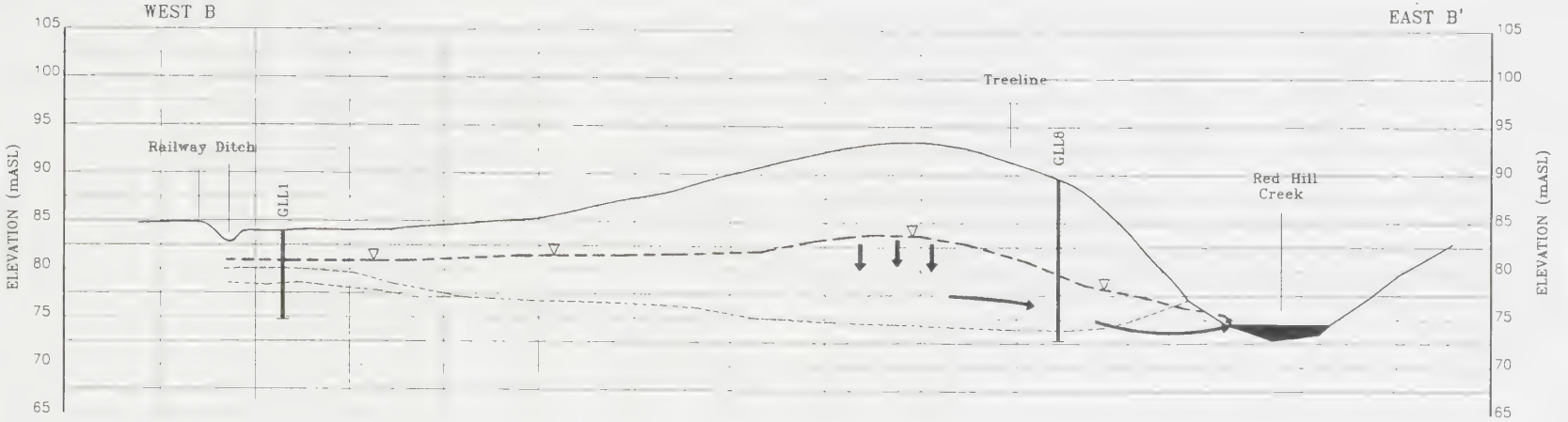
A topographic survey for the site was completed with the scale of 1:500 in the fall of 1995. The surface elevation contours measured from the survey have been reduced and shown on Figure 1. In general, surface elevations range from about 75 mASL along the northeast limit of the landfill and about 76 mASL along the southeast boundary of the site, to 93.5 mASL on top of the landfill. The landfill forms a northeast-southwest elongated mound with a steep slope towards Redhill Creek located immediately on the east side of the landfill. The side slopes of the landfill are steep along the east and south sides, ranging from about 30 to 60%. Along the western and northern sides of the landfill the slopes are generally in the order of about 10 to 20%. A gully is located along the south perimeter of the site.

3.2 Hydrogeology

The site is located in a lowland marshy area in the Redhill Creek watershed. The landfill is underlain by a silt till unit which overlies the shale bedrock of Queenston Formation. As shown in Cross-Sections A-A' and B-B' (Figure 2), the thickness of the silt till is found to be about 7 m in borehole GLL-7. The fill disposed of at the site has a thickness of about 15 m at location GLL-8. In the southern portion of the landfill where a 93 m topographic contour loops (Figure 1), the fill reaches a maximum depth of about 18 m (Cross-Section B-B', Figure 2). The fill, which reportedly contains a mixture of residential and commercial refuse, sewage sludge, foundry sand and construction rubble, is expected to be highly heterogeneous in terms of hydraulic properties. A shallow groundwater flow system exists in this thick fill material which is more permeable than the underlying silt till.

A thin peat layer is found between the fill and silt till at location GLL-1 as well as in the silt at GLL-11. A thicker peat layer (about 5 m) is also found beneath the fill in borehole GLL-10 (Appendix A). These confirm that the landfill was developed in a lowland marshy area.





LEGEND

- Fill
- Silt
- Silt Till
- Peat
- Shale
- Inferred shallow ground water flow direction

GLL11
- Borehole Location and Identification
- Original Ground
- Inferred Stratigraphic Contact
- Perched Water (Sept. 9, 1998)
- Water Table (Sept. 9, 1998)
- Seep

NOTES:

Stratigraphy between boreholes is inferred and may vary from that shown.

SCALES
HORIZONTAL 1:1000
10m 0 20m 40m
5m 0 10m 20m
VERTICAL 1:500

Former Brampton Street Landfill
Region of Hamilton-Wentworth

GEOLOGICAL CROSS SECTIONS
A-A' AND B-B'

Designed By:	Y.S.	Drawn By:	J.M.C.
Checked By:	Y.S.	Approved By:	Y.S.
Date Issued:	APRIL 1999	Project No.	98-216
Site Name:		File Name:	XSECT-3.DWG

Gartner Lee

FIGURE 2

As shown in Figure 2, the bedrock surface, found at a depth of about 6 m at GLL-11 and 9 m at GLL-7, dips east towards the creek. The shallow bedrock beneath the silt till is likely fractured and weathered and, therefore, considered as a deeper groundwater flow system in the area.

Based on regional studies, the groundwater flow in the shallow bedrock in the vicinity of the landfill site is generally from the southwest to the northeast, discharging to Lake Ontario. At the site, the groundwater table is present in the fill and forms a gentle mound in the landfill as shown in Cross-Section B-B' (Figure 2). Figure 3 demonstrates the current water table configuration beneath the site. Both Figures 2 and 3 show that the shallow groundwater flows mainly downward and outward from the landfill. It discharges directly into the creek or in the form of seeps along the east and south toes of the landfill.

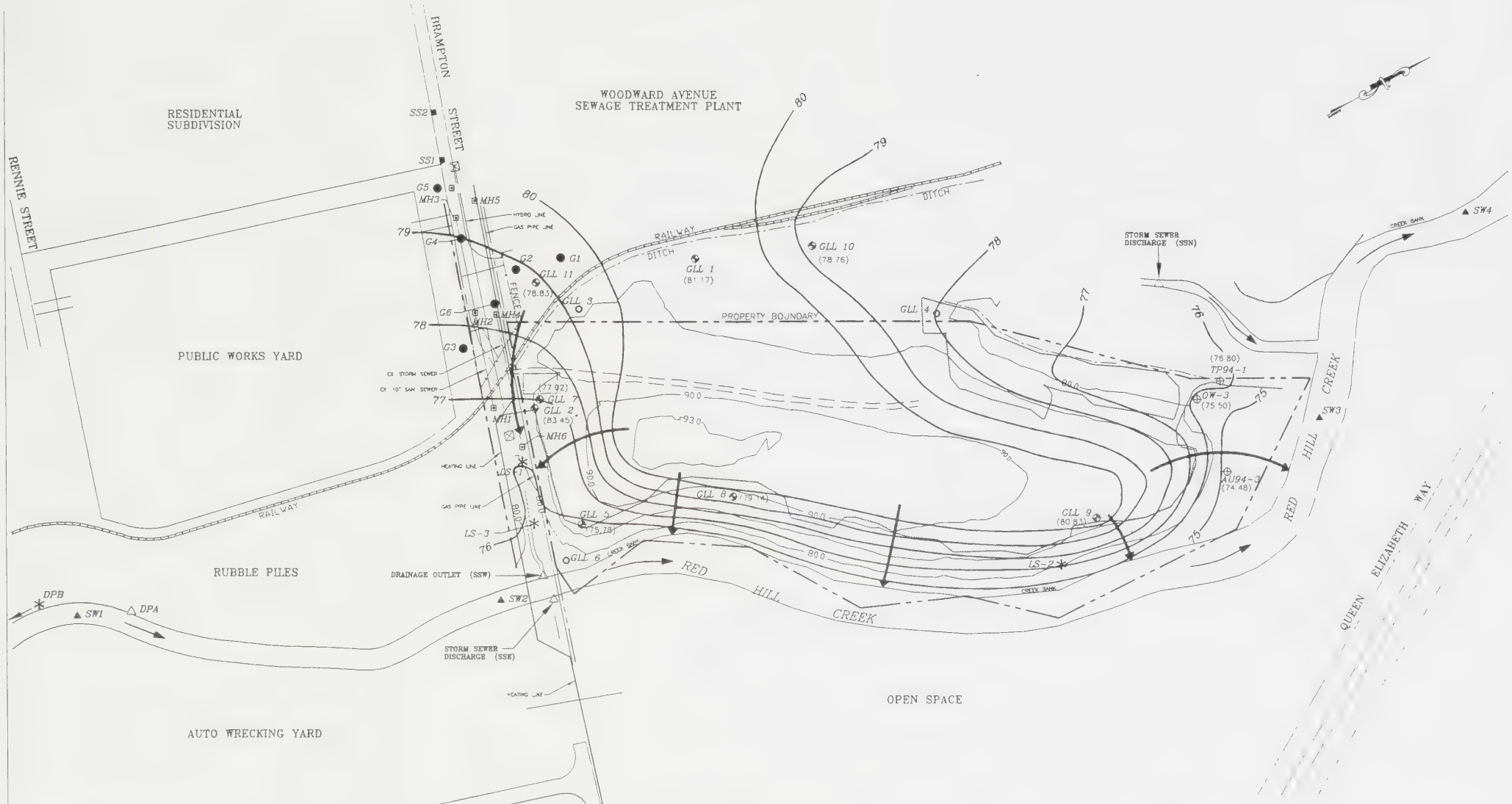
As shown in Figure 3, groundwater seeps LS-1 and LS-3 are locate in the gully along the south toe of the landfill, and seep LS-2 found on the slope of the northeast bank of the site. These seeps are leachate impacted. Based on recommendations in the 1996/1997 Monitoring Report, these seeps have been covered to prevent human/animal contact with the seeps.

Groundwater level data collected are presented in Appendix B. Based on the data available, the depth to water table at the site varies between about 3 and 14 m below ground surface. The fluctuation of water levels was less than 1 m at most of the monitoring locations. Perched water table may be found in the landfill at shallower depths, especially in wet weather. Perched conditions likely occurred in borehole GLL-2 where the groundwater elevation was very high compared to nearby locations. Monitor GLL-2 is screened in the waste overlying a silty layer which has likely caused the perched condition.

The 1998 water levels were measured from all on-site groundwater monitors monthly from July to December 1998. The groundwater elevation at each monitor shows a consistent declining trend through the summer and fall of 1998. This is attributed to the abnormally dry condition experienced during the last two years.

3.3 Hydrology

Regionally, the site is located in the Redhill Creek watershed of the Lake Ontario drainage basin. Redhill Creek drains an area of about 5,700 ha and flows northward in the vicinity of the site towards Lake Ontario. The axis of the elongated mound forms the surface drainage divide on the site. Runoff on-site drains both east into the creek and west toward a ditch located along the western edge of the site (Figure 1). This ditch eventually drains to the creek. Runoff in the gully located along the south perimeter of the site drains east and directly discharges into the creek.



LEGEND

- ▲ SW1 – SURFACE WATER MONITORING/ BENTHICE INVERTEBRATE SAMPLING STATION
- △ SSE – MONITORING STATION AT STORM SEWER DISHCHARGE
- ⊕ GLL 8 – EXISTING MONITORING WELL INSTALLED BY GLL
- ○ GLL 3 – BOREHOLE DRILLED IN 1995 WITHOUT INSTALLATION OF MONITOR
- ⊕ OW-3 – EXISTING MONITORING WELL INSTALLED BY OTHER CONSULTANTS
- ✱ LS-1 – APPROXIMATE LOCATION OF GROUND WATER SEEP
- ● G5 – SHALLOW GAS MONITOR
- ▣ MH2 – SEWER GAS MONITORING LOCATION
- → – SURFACE WATER FLOW DIRECTION
- 90.0 – TOPOGRAPHIC CONTOURS (mASL)
- ~~~ – TREELINE
- ● (79.21) – WATER TABLE ELEVATION (mASL)
- (83.52)* – PERCHED SHALLOW GROUND WATER LEVEL
- — 80 — – INFERRED WATER TABLE CONTOUR (SEPT. 5, 1997)
- → – INFERRED SHALLOW GROUND WATER FLOW DIRECTION

No.	Description	Date	By
	Revisions		

1:2500
Scales

Designed By:	Y.S.	Drawn By:	J.G.L.
Checked By:		Approved By:	
Date Issued:	APRIL 1999	Project No.	98-216
Site Name		File Name:	98216F02.DWG

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FORMER BRAMPTON STREET LANDFILL SITE
HAMILTON WENTWORTH

SHALLOW GROUND WATER ELEVATIONS
(SEPTEMBER 9, 1998)

FIGURE 3

Manual monitoring of flow in the creek was difficult because the water was deep in the creek and the flow was too slow to be measured or to allow reliable data to be collected. The very slow flow is due to a very small hydraulic gradient in the creek between the site and the lake. The Lake Ontario water level fluctuates by up to about 0.6 m. Every time the water level rises in the lake, the flow in the creek is slowed down. No manual flow data were collected during this monitoring year. With the remediation of the gully south of the site to eliminate contact with LS-1 and LS-3, flow data can no longer be collected from the SSW discharge point.

Flow in Redhill Creek is also measured on a regular basis by a well equipped Environment Canada Flow Station located at Queenston Road in Hamilton (Station #02HA014). The 1998 daily flow data from this station have been compiled and presented in Appendix C. The data show that the daily average flow in the creek ranged between 16 L/s and 17,600 L/s in 1998. Based on the monthly average rate and total flow data, the low flow season occurred in the summer and fall with the lowest flow measured in November, 1998. The high flow season was observed in the spring with the highest flow occurring in March after snow melt.

3.4 Water Balance

A long term water budget for the study area has been completed based on the 1967 to 1990 meteorological data from Hamilton Municipal Laboratory Meteorological Station. The results, found in Appendix F, show that the average yearly precipitation and evapotranspiration in the area is about 848 mm and 564 mm, respectively. The actual water surplus (precipitation minus evapotranspiration) is about 284 mm/year which is available for runoff and infiltration.

The Ministry of Environment and Energy (MOEE) published "Technical Information Requirements for Land Development Applications" (April 1995) to estimate infiltration on a site based on topography, the types of soil and cover on-site. According to the approaches presented in this document, the infiltration factor for the site is estimated to be about 0.6, equivalent to a runoff coefficient of 0.4.

Based on the average water surplus of 284 mm/year and the infiltration factor of 0.6, an average infiltration rate of about 170 mm/year would take place on the site. Given that the site area is about 7.5 ha, the total infiltration is estimated to be about 0.4 L/s. Assuming all infiltration on-site generates leachate in the landfill, the leachate production rate would be about 0.4 L/s. Based on the water table mounding present at the site, leachate is only generated through infiltration.

4. Landfill Impact Assessment

4.1 Leachate Quality

The 1998 leachate quality data were collected from leachate monitor GLL-9 and leachate seeps LS-1 and LS-3. The 1998 data are presented in Appendix B along with historical data, including general water quality parameters, trace metals and organic compounds. In general, the concentrations were stable throughout most of 1998, but slightly higher for some parameters compared to past results. Most metals in GLL-9 were noticeably elevated on July 17, 1998, compared to other sampling dates for the monitor. The results are likely related more to sampling or analytical protocols than the actual water quality since the metals in the October 1998 sample were similar to previous results. At LS-3, the aluminum, chromium, zinc and iron concentrations were elevated over past results. The extremely high iron concentrations 51 mg/L in February and 323 mg/L in May would indicate there was considerable sediment in these samples. The downstream sampling location SSW showed concentrations similar to historic results on all occasions in 1998 indicating the elevated metals in the sediment are not reaching Redhill Creek.

The 1998 water quality data have been reduced in terms of a set of typical leachate indicator parameters and summarized in Table 2. As similar to 1996 and 1997, the landfill leachate in monitor GLL-9 is characterized by elevated electrical conductivity, alkalinity, chloride, ammonia, organic nitrogen, TKN, COD, DOC, sodium, magnesium, potassium, iron, manganese, barium and boron, in comparison with the relevant provincial water quality criteria for ground and surface water. The water quality in leachate seeps LS-1 and LS-3 are also characterized by elevated levels of the above parameters (Table 2).

The 1998 organic analysis results found in Appendix B show that only trace levels of a few organic compounds were detected in the samples collected from GLL-9. These trace levels are all below relevant provincial guidelines for surface water and groundwater quality with the exception of ethylbenzene, toluene and m&p-xylenes. The 1998 data show an increase in concentration of the three parameters compared to the 1996 levels. In 1998, ethylbenzene at GLL-9 consistently exceeded the guidelines for both surface water and groundwater. Toluene and m&p-xylenes slightly exceeded the guidelines for only surface water. The low levels of these three parameters found in 1998 at GLL-9 will not likely have caused a significant impact on the surface water quality in Redhill Creek as a result of the dilution potential of the creek. It is recommended that the summer and spring surface water samples collected from SW2, SW3, SSW and SSE be analyzed for the volatile organics within Misa Group #17.

LS-3, located downslope of LS-1, formed in 1996 due to construction of the trench for the steam heating line in 1996. Water quality in LS-3 is generally comparable to LS-1 except iron which is significantly lower in LS-3 (Table 2). Ammonia and TKN in LS-3 are slightly higher than those in LS-1. Leachate seeps LS-1 and LS-3 were covered with riprap and seeded in 1998 to mitigate the aesthetic impact and prevent human/animal from contact with the seeps.

Table 2: 1998 Leachate Quality

Closed Brampton Street Landfill, Hamilton

ANALYTICAL PARAMETERS			ODWO	PWQO	Leachate Seep LS-1		Leachate Seep LS-3		Leachate Monitor GLL 9			
					19-Feb-98	06-May-98	19-Feb-98	06-May-98	19-Feb-98	06-May-98	17-Jul-98	10-Aug-98
General Parameters												
Conductivity (Field)		us/cm			5180	6780	3750	6700	7700	7840	8230	8480
Alkalinity		mg/L	30-500**		540	697	635	796	2390	2600	2430	2460
Chloride	CL	mg/L	250*		1460	1950	830	1880	1360	1360	1180	1250
Nitrate	NO3	mg/L	10		1.74	<0.10	0.463	<0.10	<0.025	0.17	<0.03	<0 03
Nitrite	NO2	mg/L	1		<0.06	<0.10	<0.06	<0.10	<0.12	<0.10	<0.03	<0.03
Ammonia	NH3	mg/L			14.4	19.4	33.4	39.3	504	530	499	458
Un-ionized Ammonia	Free NH3	mg/L		0.02	0.0723	0.1268	0.8232	0.8054	6.3340	4.8421	7.3518	6.3036
Total Kjeldahl Nitrogen	TKN	mg/L			15.6	44.4	35.1	49.7	519	530	554	577
Organic Nitrogen	Ogn-N	mg/L	0.15**		1.2	25	1.7	10.4	15	0	55	119
Phenols		mg/L		0.001	0.033	0.036	0.003	0.006	0.011	0.006	0.004	0.008
Total Phosphorus	P	mg/L		0.03	0.64	10.8	0.107	1.1	1.12	-	-	-
Chemical Oxygen Demand	COD	mg/L							1270	1170	1280	1320
Dissolved Organic Carbon	DOC	mg/L	5*						314	320	222	307
Metals												
Sodium	Na	mg/L	200*		813	1230	545	1090	716	746	740	715
Calcium	Ca	mg/L			169	264	113	161	62	46.3	44.5	51.7
Magnesium	Mg	mg/L			57.8	68.2	119	101	112	102	96.2	102
Potassium	K	mg/L			19.4	23	41.9	45	275	311	280	289
Iron	Fe	mg/L	0.3*	0.3	51	323	1.98	4.31	1.66	1.32	3.45	1 14
Manganese	Mn	mg/L	0.05*		0.566	-	0.423	-	0.17	-	-	-
Barium	Ba	mg/L	1		0.979	3	0.261	0.547	-	0.564	2.39	0 692
Boron	B	mg/L	5	0.2	-	0.66	-	1.2	-	1.6	1.6	1 6

ODWO - Ontario Drinking Water Objectives for health related parameters (1994); * - aesthetic parameters; ** - operational parameters
PWQO - Provincial Water Quality Objectives (July 1994)
Un-ionized ammonia values for GLL-9 calculated assuming groundwater temperature equals 9^0C
- Filtered samples, otherwise unfiltered samples
- No data available

4.2 Surface Water Quality

4.2.1 General Water Quality

1998 water quality data for Redhill Creek including both inorganic and organic parameters are presented along with historical data in Appendix C, in comparison with the Provincial Water Quality Objectives (PWQO). Total phosphorus and several metals such as iron, copper, zinc and aluminum often exceeded the PWQO in 1998 at all the surface water stations including SW1 and SW2 located upstream of the landfill. The PWQO for un-ionized ammonia was slightly exceeded at station SW3 during only the February 1998 monitoring. The un-ionized ammonia at other three surface water stations were all below the guideline during the four monitoring events. With a few exceptions, the exceedances occurred both upstream of the landfill in the background stations and downstream of the landfill. Loading contribution to the creek also occurred from other sources such as groundwater/leachate seeps and storm sewer outfalls.

To assess possible leachate impacts, the concentrations of typical leachate indicator parameters were compared between upstream and downstream locations. These are summarized on Tables 2 and 3. Of the leachate indicator parameters, Table 3, shows that a number of parameters are on occasion slightly elevated downstream of the landfill at SW3, compared to the upstream station SW2. For most parameters, any increases downstream did not cause exceedances of PWQOs. Only the iron concentration is usually higher downstream at SW3 and exceeds the PWQO for the unfiltered samples only. The iron objective is for total iron and not filtered iron. The un-ionized ammonia objective was exceeded compared to SW2 on one occasion, February 1998, and the total phosphorus objective was exceeded at SW3 compared to SW2 on two occasions (May and October 1998).

Figure 4 demonstrates measured iron concentrations in the creek in terms of sampling locations (Figure 4-1) and sampling events (Figure 4-2). Figures 4-1 and 4-2 show that most iron concentrations measured at the upstream and downstream locations exceeded the PWQO for iron (0.3 mg/L) in 1998. Fourteen samples of the total 16 samples collected (about 88%) exceeded the PWQO for iron. The graphs (Figure 4) also show that slight increases in iron concentration occurred from the upstream SW2 to downstream SW3 during three of the four sampling events.

The source and significance of any elevated concentrations are discussed in the next section.

4.2.2 Assessment of Loading on Redhill Creek

To assess the significance of any landfill impact on the stream, the water quality data from SW2 and SW3 as well as from major sources of loading input located between SW2 and SW3 were studied. SW2 is considered to be a background station for this assessment. SW3 is located immediately downgradient of the landfill. As the drainage outlet of the gully along the south perimeter of the landfill, SSW is

FIGURE 4-1: IRON CONCENTRATION IN REDHILL CREEK

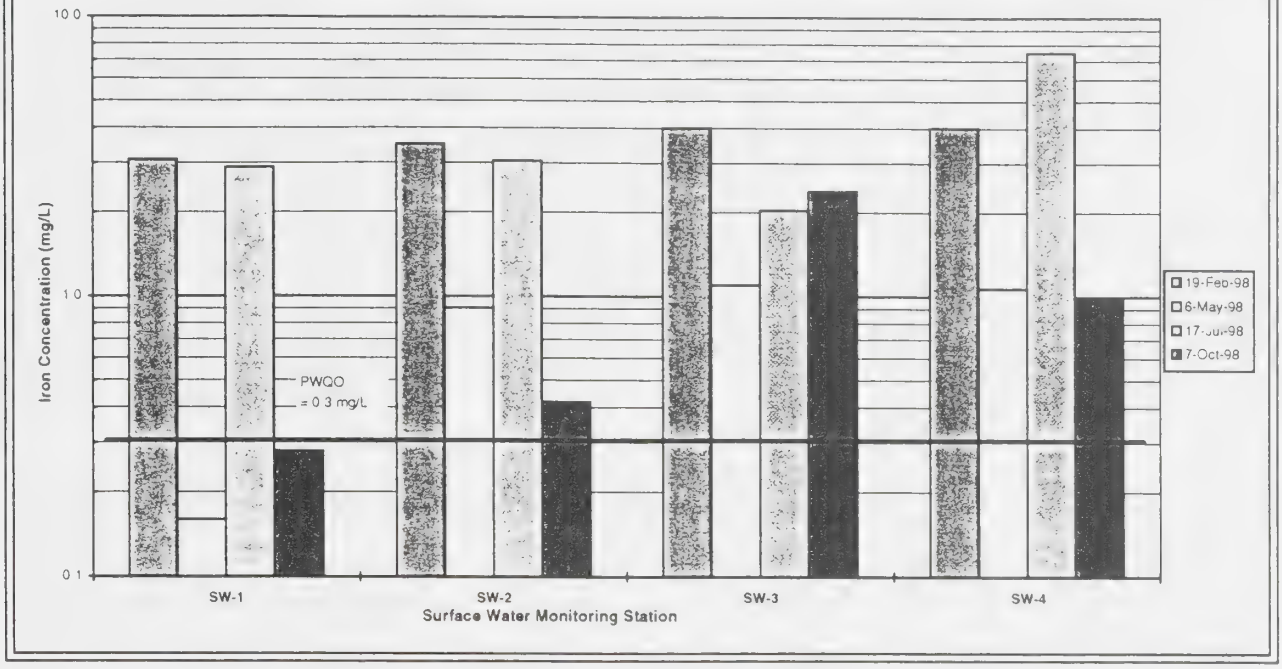

FIGURE 4-2: IRON CONCENTRATIONS IN REDHILL CREEK

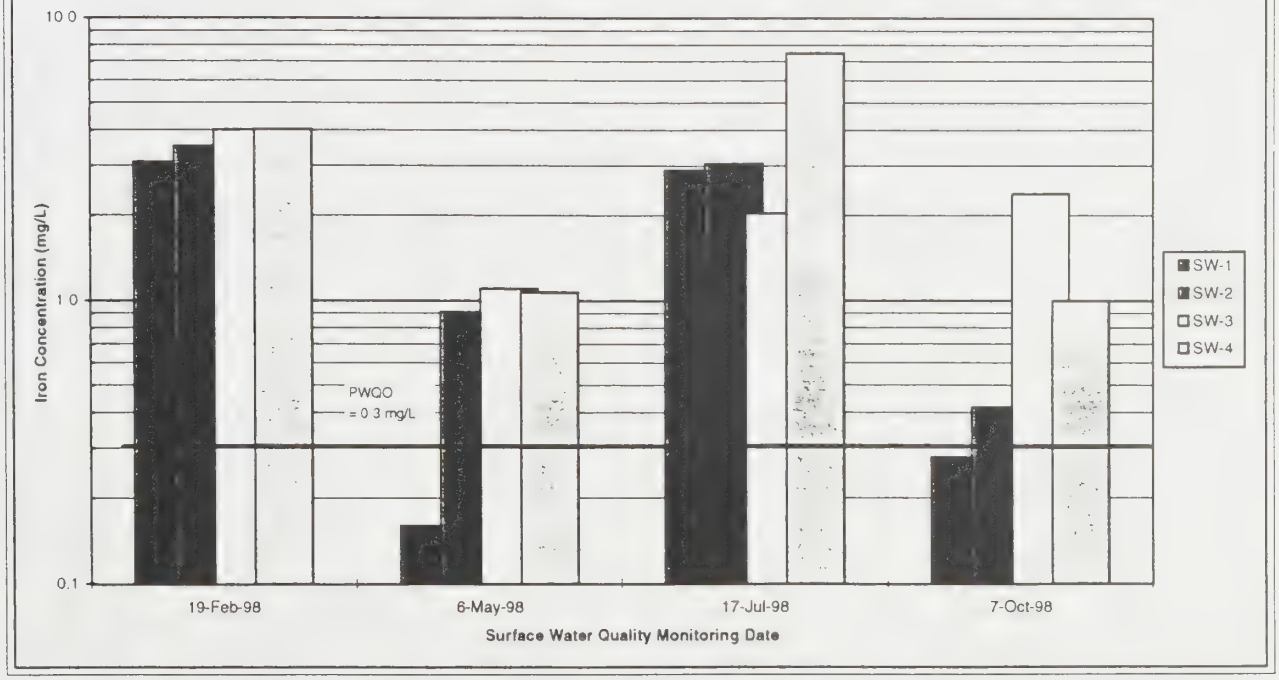

TABLE 3: COMPARISON OF 1998 WATER QUALITY IN REDHILL CREEK BETWEEN UPSTREAM AND DOWNSTREAM STATIONS

Analytical Parameter			PWQO	19-Feb-98		06-May-98		17-Jul-98	23-Jul-98	07-Oct-98	
				SW-2	SW-3	SW-2	SW-3	SW-2	SW-3	SW-2	SW-3
General Parameters											
Conductivity (Field)		us/cm		891	843	1650	1300	763	-	1340	364
Total Suspended Solids	TSS	mg/L		67	81	16.6	23.8	46.6	-	8.8	39
Alkalinity		mg/L		126	119	208	158	122	171	169	67
Chloride	CL	mg/L		161	151	282	205	100	203	196	41
Nitrate	NO3	mg/L		2.56	2.35	1.46	<0.1	2.05	-	0.98	0.97
Nitrite	NO2	mg/L		<0.012	<0.012	<0.10	<0.10	0.051	-	<0.03	<0.03
Ammonia	NH3-N	mg/L		0.65	1.21	0.52	0.3	0.2	0.55	0.59	0.08
Total Kjeldahl Nitrogen	TKN	mg/L		2.2	2	1.8	1.6	1.3	1.6	1.7	0.8
Unionized NH3	Free NH3	mg/L	0.02	0.0159	0.0305	0.0139	0.0178	-	-	0.01539	0.00261
Total Phosphorus	P	mg/L	0.01	0.323	0.304	0.059	0.157	0.161	0.12	0.096	0.148
Phenols		mg/L	0.001	<0.003	<0.003	0.005	<0.003	<0.003	<0.003	<0.003	0 004
Metals											
Sodium	Na	mg/L		104	94	156	119	63.2	120	114	29.1
Calcium	Ca	mg/L		65.4	62.9	109	99.2	64.3	108	105	30.9
Magnesium	Mg	mg/L		18.4	17.5	36.4	28.3	15.9	32.3	30.3	7
Potassium	K	mg/L		5.1	5	6	6	4.9	6.7	6.2	3
Iron	Fe	mg/L	0.3	3.51 (0.19)	4.02 (0.22)	0.91 (0.06)	1.1 (0.05)	3.06 (0.08)	2.04 (0.07)	0.42 (0.07)	2.39 (0.11)
Manganese	Mn	mg/L		0.08	0.109	0.138	-	-	-	-	-
Barium	Ba	mg/L		0.052	0.051	0.065	0.053	0.068	0.079	0.059	0.029
Boron	B	mg/L	0.2	-	-	0.16	0.11	-	0.17	0.18	0.051

PWQO - Provincial Water Quality Objectives (July 1994);

- No data available

Values in brackets are iron concentrations in filtered samples, other metals concentrations in filtered samples are found in Appendix C.

Surface Water Stations SW-2 and SW-3 are located in Redhill Creek upstream and immediately downstream of the potential landfill impact zone

located downstream from the existing storm sewer manhole and leachate seeps LS-1 and LS-3 (Figure 1). The 1998 water quality at SSW reflects a mixture of waters from overland flow in the gully, the storm sewer discharge, and both seeps LS-1 and LS-3. SSE is the storm sewer outfall located across the creek from SSW. Loadings also came from the landfill by direct discharge of leachate impacted groundwater to the creek. SSW (including LS-1 and LS-3), SSE and flow from the landfill all contribute to the stream between SW2 and SW3. In addition to the known input to the stream, there are also natural groundwater inputs and seepage from fill materials on the east side of the creek.

The 1998 water quality data from SW2 and SW3 are summarized in Table 3 in terms of typical landfill leachate indicator parameters. Table 2 shows the 1998 leachate quality data from monitor GLL9. Table 4 summarizes 1998 water quality data from the loading contributors SSW and SSE based on the leachate indicator parameters. All these data were used to calculate the contribution to Redhill Creek from the landfill and other sources.

As discussed earlier, the nature of the stream itself is noticeably different between the upstream and downstream stations. Upstream, at SW1, the stream is narrower and has a rockier base. Downstream (SW2, SW3 and SW4), the stream is wider and the base is mainly silty clay. As a result, the stream appears muddier near the north end.

Landfill impacts on the stream were assessed through loading calculations for selected leachate indicator parameters. A chemical loading at a station should equal the measured concentration for that chemical multiplied by the measured flow rate at that station. The loading at the downstream station SW3 should equal the loading at the upstream station SW2 plus all loading input from between SW2 and SW3 including SSW (LS-1, LS-3 and stormwater), SSE and the landfill. Based on these concepts, theoretical parameter concentrations at SW3 were calculated based on two scenarios: one with and one without landfill loading contribution. The difference in concentration between the two scenarios, therefore, reflects the theoretical loading contribution from the landfill through the addition of groundwater seepage and leachate seeps. To calculate the expected change in water quality between SW2 and SW3 without the landfill, the SSE and SW2 loadings and flow were added together to determine the SW3 without the landfill. To calculate the expected SW3 concentration with the landfill, the SSW, SSE and landfill seepage were added to SW2 to determine the expected concentration. Since seepage from the east side of the landfill was observed from one location (LS-2), we have assumed a small contribution from seeps, with a chemical composition similar to LS-1.

The results of the loading calculation are presented in Tables 5-1 and 5-2 for all the four monitoring events in 1998. The July results do not include SW3 since this sample was not collected on the same day as the others and is not comparable. These calculations are performed under the following conservative assumptions.

TABLE 4: SUMMARY OF WATER QUALITY IN STORM WATER DISCHARGES IMMEDIATELY UPSTREAM OF LANDFILL

Analytical Parameter			PWQO	19-Feb-98		06-May-98		17-Jul-98		07-Oct-98	
				SSW	SSE	SSW	SSE	SSW	SSE	SSW	SSE
General Parameters											
Conductivity (Field)		us/cm		3920	1020	1740	1500	798	916	1480	1330
Total Suspended Solid	TSS	mg/L		76	143	30	25.2	-	22.8	32.6	139
Alkalinity		mg/L		509	144	211	206	130	136	175	253
Chloride	CL	mg/L		966	156	300	279	116	104	234	162
Nitrate	NO3	mg/L		1.24	1.49	1.41	1.43	1.94	1.15	0.99	0.82
Nitrite	NO2	mg/L		<0.06	0.064	<0.10	<0.10	0.085	0.038	<0.03	<0.03
Ammonia	NH3-N	mg/L		16.2	0.24	1.06	0.5	0.47	0.07	0.88	0.59
Total Kjeldahl Nitrogen	TKN	mg/L		17.7	2.3	1.9	1.3	2	1.9	2.1	2.8
Unionized NH3	Free NH3	mg/L	0.02	0.3288	0.0369	0.0387	0.0189	0.01463	0.0014	0.02469	0.01384
Total Phosphorus	P	mg/L	0.01	0.133	0.248	0.077	0.045	0.228	0.094	0.113	0.576
Phenols		mg/L	0.001	0.006	0.019	<0.003	0.003	0.005	<0.003	<0.003	0.58
Metals											
Sodium	Na	mg/L		630	85	166	157	68	63.3	171	75.2
Calcium	Ca	mg/L		131	109	112	117	63.4	70.3	109	154
Magnesium	Mg	mg/L		78.9	23.5	37.4	37.3	15.8	16.9	31.9	31
Potassium	K	mg/L		27.9	13.7	7	7	5.1	6.5	7.7	9.5
Iron	Fe	mg/L	0.3	1.89	4.48	1.05	1.09	4.25	2.96	2.92	4.45
Manganese	Mn	mg/L		0.498	0.557	-	-	-	-	-	-
Barium	Ba	mg/L		0.306	0.082	0.069	0.071	0.065	0.06	0.09	0.206
Boron	B	mg/L	0.2	-	-	0.17	0.16	-	-	0.21	0.18

PWQO - Provincial Water Quality Objectives (July 1994)

- No data available

SSW and storm sewer outfall SSE are located downstream of surface water station SW-2 and immediately upstream of the potential landfill impact zone

Gartner Lee

TABLE 5-1: CALCULATIONS OF LANDFILL LOADING CONTRIBUTION TO REDHILL CREEK

Leachate Indicator Parameter		PWQO	Measured Concentration and Flow - February 19, 1998						Measured Concentration and Flow - May 6, 1998					
			Upstream Station	Storm Water Discharge		Leachate Seep	Leachate Discharge from Landfill	Downstream Station	Upstream Station	Storm Water Discharge		Leachate Seep	Leachate Discharge from Landfill	Downstream Station
			SW-2	SSW	SSE	LS-2 / LS-1	GLL-9	SW-3	SW-2	SSW	SSE	LS-2 / LS-1	GLL-9	SW-3
Flow (L/s)			5140	0.47	12.7	0.03	0.48	5153.68	200	0.35	9.52	0.15	0.48	210.5
Fe	mg/L	0.3	3.51	1.89	4.48	51	1.66	4.02	0.91	1.05	1.09	323	1.32	1.1
Mn	mg/L		0.08	0.498	0.557	0.566	0.17	0.109	0.138	-	-	-	-	-
Ba	mg/L		0.052	0.306	0.082	0.979	0.564	0.051	0.065	0.069	0.071	3.00	0.564	0.053
B	mg/L	0.2	-	-	-	-	-	-	0.16	0.17	0.16	0.66	1.6	0.11
TKN	mg/L		2.2	17.7	2.3	15.6	519	2.00	1.8	1.9	1.3	44.4	530	1.6
NH_3	mg/L		0.65	16.2	0.24	14.4	504	1.21	0.52	1.06	0.5	19.4	530	0.3
Un-ionized NH3	mg/L	0.02	0.0159	0.3288	0.0369	0.0723	6.3340	0.0305	0.0139	0.0387	0.0189	0.1268	4.8421	0.018
Org-N	mg/L		1.550	1.50	2.060	1.2	15	0.790	1.280	0.840	0.800	25	0	1.3
NO_3	mg/L		2.56	1.24	1.49	1.74	0.0125	2.35	1.46	1.41	1.43	0.05	0.17	<0.1
Cl	mg/L		161	966	156	1460	1360	151	282	300	279	1950	1360	205
Na	mg/L		104	630	85	813	716	94	156	166	157	1230	746	119
Ca	mg/L		65.4	131	109	169	62	62.9	109	112	117	264	46.3	99 2
Mg	mg/L		18.4	78.9	23.5	57.8	112	17.5	36.4	37.4	37.3	68.2	102	28.3
K	mg/L		5.1	27.9	13.7	19.4	275	5	6	7	7	23	311	6
Alkalinity	mg/L CaCO3		126	509	144	540	2390	119	208	211	206	697	2600	158
Total P	mg/L	0.03	0.323	0.133	0.248	0.64	1.12	0.304	0.059	0.077	0.045	10.8	1.72	0.157

Leachate Indicator Parameter		PWQO	Calculated Concentration at SW-3 (Feb 19, 1998)			% of Total Loading From Landfill	Calculated Concentration at SW-3 (May 6, 1998)			% of Total Loading From Landfill
			With Landfill Contribution SW2, SSW, SSE, and GLL9		Without Landfill Contribution SW2, SSE		With Landfill Contribution SW2, SSW, SSE, and GLL9		Without Landfill Contribution SW2, SSE	
Fe	mg/L	0.3	3.5123	-13%	3.5117	0.018	1.149	4%	0.914	20.45
Mn	mg/L		0.08122	-25%	0.08116	0.079	-		-	-
Ba	mg/L		0.0522	2%	0.0521	0.17	0.069	29%	0.065	5 17
B	mg/L	0.2	-		-	-	0.164	49%	0.159	2.69
TKN	mg/L		2.250	12%	2.200	2.22	3.01	88%	1.77	41.3
NH_3	mg/L		0.697	-42%	0.649	6.96	1.74	480%	0.517	70.3
Un-ionized NH3	mg/L	0.02	0.017	-46%	0.016	3.74	0.0253	42%	0.0141	44.3
Org-N	mg/L		1.553	97%	1.551	0.10	1.27	-2%	1.25	1.51
NO_3	mg/L		2.5570	9%	2.5569	0.005	1.45		1.45	0.190
Cl	mg/L		161.2	7%	161.0	0.14	285.5	39%	280.6	1 75
Na	mg/L		104.1	11%	103.9	0.12	158.2	33%	155.3	1.80
Ca	mg/L		65.51	4%	65.50	0.029	109.3	10%	108.9	0 439
Mg	mg/L		18.43	5%	18.41	0.10	36.61	29%	36.27	0 94
K	mg/L		5.148	3%	5.120	0.55	6.75	13%	6.02	10.91
Alkalinity	mg/L CaCO3		126.3	6%	126.0	0.22	213.7	35%	206.9	3.17
Total P	mg/L	0.03	0.3229	6%	0.3228	0.037	0.070	-56%	0.058	16.82

Notes:

Flow from Environment Canada Gauge Station in Redhill Creek at Queenston Road used for SW-2; Flow at SW-3 calculated based on SW-2 plus inflows between SW-2 and SW-3

Flow rate for LS-1 estimated; flow for leachate discharge from landfill calculated assuming silt till with a hydraulic conductivity of $5x10^{-5}$ cm/s

75 % of flow measured at SSW and SSE on Feb. 19, 1998 are used for May 6, 1998 monitoring event;

Data for dissolved P in GL-9 used for May 6, 1998 monitoring event;

Data for Ba in GL-9 measured on May 6, 1998 are used for Feb. 19, 1998 monitoring event

- No data available

TABLE 5-2: CALCULATIONS OF LANDFILL LOADING CONTRIBUTION TO REDHILL CREEK

Leachate Indicator Parameter		PWQO	Measured Concentration and Flow - July 17, 1998						Measured Concentration and Flow - Oct. 7, 1998					
			Upstream Station	Storm Water Discharge		Leachate Seep	Leachate Discharge from Landfill	Downstream Station	Upstream Station	Storm Water Discharge		Leachate Seep	Leachate Discharge from Landfill	Downstream Station
			SW-2	SSW	SSE	LS-2 / LS-1	GLL-9	SW-3	SW-2	SSW	SSE	LS-2 / LS-1	GLL-9	SW-3
Flow (L/s)			699	0.24	6.35	0.01	0.48	706.08	988	0.12	3.17	0.01	0.48	991.78
Fe	mg/L	0.3	3.06	4.25	2.96	323	3.45	Sampled at a later date	0.42	2.92	4.45	323	1.14	2.39
Mn	mg/L		-	-	-	-	-		-	-	-	-	-	
Ba	mg/L		0.068	0.065	0.06	3	2.39		0.059	0.09	0.206	3.0	0.692	0.029
B	mg/L	0.2	-	-	-	0.66	1.6		0.18	0.21	0.18	0.66	1.6	0.051
TKN	mg/L		1.3	2	1.9	44.4	554		1.7	2.1	2.8	44.4	577	0.8
NH3	mg/L		0.2	0.47	0.07	19.4	499		0.59	0.88	0.59	19.4	458	0.08
Un-ionized NH3	mg/L	0.02		0.015	0.001	0.127	7.4		0.015	0.025	0.014	0.127	6.304	0.003
Org-N	mg/L		1.100	1.530	1.830	25	55		1.110	1.220	2.210	25	119	0.72
NO3	mg/L		2.05	1.94	1.15	0.05	0.015		0.98	0.99	0.82	0.05	0.015	0.97
Cl	mg/L		100	116	104	1950	1180		196	234	162	1950	1250	41
Na	mg/L		63.2	68	63.3	1230	740		114	171	75.2	1230	715	29.1
Ca	mg/L		64.3	63.4	70.3	264	44.5		105	109	154	264	51.7	30.9
Mg	mg/L		15.9	15.8	16.9	68.2	96.2		30.3	31.9	31	68.2	102	7
K	mg/L		4.9	5.1	6.5	23	280		6.2	7.7	9.5	23	289	3
Alkalinity	mg/L CaCO3		122	130	136	697	2430		169	175	253	697	2460	67
Total P	mg/L	0.03	0.161	0.228	0.094	10.8	1.34		0.096	0.113	0.576	10.8	1.12	0.148

Leachate Indicator Parameter		PWQO	Calculated Concentration at SW-3 (July 17, 1998)		% of Total Loading From Landfill	Calculated Concentration at SW-3 (Oct.7, 1998)		% of Total Loading From Landfill
			With Landfill Contribution SW2, SSW, SSE, and GLL9	Without Landfill Contribution SW2, SSE		With Landfill Contribution SW2, SSW, SSE, and GLL9	Without Landfill Contribution SW2, SSE	
Fe	mg/L	0.3	3.064	3.056	0.27	0.437	0.433	0.95
Mn	mg/L		-	-	-	-	-	-
Ba	mg/L		0.0695	0.0679	2.43	0.060	0.059	0.63
B	mg/L	0.2	-	-	-	0.181	0.180	0.45
TKN	mg/L		1.682	1.304	22.5	1.982	1.702	14.1
NH_3	mg/L		0.538	0.199	63.1	0.812	0.590	27.3
Un-ionized NH3	mg/L	0.02	-	-	-	0.018	0.015	16.6
Org-N	mg/L		1.144	1.105	3.35	1.171	1.113	4.95
NO_3	mg/L		2.040	2.040	0.033	0.9790	0.9789	0.013
Cl	mg/L		100.8	99.93	0.86	196.42	195.77	0.33
Na	mg/L		63.68	63.14	0.85	114.19	113.81	0.33
Ca	mg/L		64.34	64.29	0.086	105.13	105.09	0.039
Mg	mg/L		15.96	15.89	0.45	30.34	30.28	0.18
K	mg/L		5.102	4.909	3.77	6.35	6.21	2.22
Alkalinity	mg/L CaCO3		123.7	122.0	1.38	170.38	169.16	0.72
Total P	mg/L	0.03	0.161	0.160	0.71	0.098	0.097	0.68

Notes:
Flow from Environment Canada Gauge Station in Redhill Creek at Queenston Road used for SW-2; Flow at SW-3 calculated based on SW-2 plus inflows between SW-2 and SW-3
Flow rate for LS-1 estimated; flow for leachate discharge from landfill calculated assuming silt till with a hydraulic conductivity of $5x10^{-5}$ cm/s
50% and 25% of flow measured at SSW / SSE on Feb. 19, 1998 are used for July 17 and Oct.7 monitoring events, respectively
Data for total P in GL-9 measured on Feb 19, 1998 are used for Oct.7, 1998 monitoring event. Dissolved P used for July event
Data for LS-1 measured on May 6, 1998 are used for July 17 and Oct. 7, 1998 monitoring events
- No data available

a) The flow data from the Environment Canada Gauge Station at Queenston Road were used for SW2. As the station is located about 2 km upstream of SW2, the actual flow at SW2 would have been larger than those measured at the station. This suggests that a smaller dilution factor than the actual is applied for each of the monitoring events. The stream flow used in the calculation varies from 200 to 5,140 L/s within the four monitoring events. This range of flow reflects the general low flow conditions to higher spring flow in Redhill Creek.

b) The leachate impacted groundwater in the landfill discharges through silt till into the creek. The hydraulic conductivity for silt till typically ranges between $1x10^{-4}$ to $1x10^{-6}$ cm/s. Therefore, the second conservative assumption was that a higher hydraulic conductivity of $5x10^{-5}$ cm/s was used to estimate the rate of leachate discharging to the creek. The rate of leachate discharge is estimated to be about 0.48 L/s in 1998 based on this hydraulic conductivity and 1998 hydraulic gradients. This leachate discharge rate (0.48 L/s) is comparable to and larger than the estimated leachate production rate of about 0.4 L/s from the site, as described in Section 3.4 (Water Balance). This conservative assumption ensures that 100 % leachate generated from groundwater recharge discharges into Redhill Creek in 1998.

Comparison of Calculated to Actual Concentrations

For the February 1998 results, Tables 5-1 and 5-2 show that the calculated parameter concentrations for SW3 for the scenario "with landfill contribution" are generally comparable to the measured concentrations at SW3. The more conservative parameters such as chloride, potassium and manganese are within 10% of the measured concentrations. Some nitrogen compounds (NH_3, Org-N, and Free NH_3) show greater variation between the calculated and measured concentrations for most sampling events. This is likely because the calculation does not consider complicated nitrification or denitrification processes that could occur in the stream and groundwater/leachate seeps and cause changes in concentration within the nitrogen compound group. For all other leachate indicator parameters, the calculation of the 'with landfill concentrations' vary from slightly higher to slightly lower than measured concentrations. In all cases, the increase in parameters concentrations at the downstream station were considered insignificant

The calculated concentrations for May 1998 are less comparable to the measured concentrations mainly because the concentrations for most parameters were lower downstream compared to upstream. The calculation assumes that the landfill will contribute some loading and, therefore, increases the concentrations downstream of the landfill. On this date only the iron, un-ionized ammonia, and total phosphorus increased downstream of the landfill. Of these only the iron and phosphorus exceeded the PWQO and the calculations show that the landfill contributed to less than 10% of the change in concentration.

The loading calculations for July cannot be compared to the SW3 results since the sample was collected on a different day than the other surface water samples. The concentrations are significantly higher in the latter SW3 samples than the earlier samples. Historical monitoring shows SW2 and SW3 are generally similar and the difference is attributed to the different conditions on the two sampling days.

The greatest variation between the calculated and measured concentrations at SW3 occurred for most parameters for the October 1998 sampling event (Table 5-2). This is attributed to the low concentrations measured at SW3 during the sampling event. As shown in Table 3, most major water quality parameters (conductivity, alkalinity, chloride, sodium, calcium, magnesium, TKN and ammonia) at SW3 had significantly lower concentrations on October 7 than any of other three monitoring events in 1998. Based on the 1998 precipitation data from the Hamilton Airport (Appendix E), the region experienced 17.7 mm of rainfall on October 7, 1998. This was the highest daily precipitation in the fall of 1998. These lower concentrations measured at SW3 could be related in part to dilution by rainwater on the sampling date and in part to backflow from downstream/Lake Ontario that may have occurred during the storm event. As discussed earlier, the loading calculation assumes there is an increase in concentrations downstream of the landfill.

Assessment of Loadings

Tables 5-1 and 5-2 show that the landfill contribution to the total loading in the stream was largely determined by the stream flow that diluted the leachate. For example, the highest flow (5140 L/s) occurred in the creek on February 19, 1998 while the lowest landfill contribution to the total loading was estimated. The lowest flow (200 L/s) was measured in the creek on May 6, 1998 while the highest landfill contribution to the total loading was calculated. The calculated contribution for May are significantly higher than the measured downstream concentrations indicating that some other, lower concentration contributor was influencing the water quality downstream of the landfill during that event.

- **Iron**

  During all four monitoring events in 1998, the measured iron concentrations slightly exceeded the PWQO (0.3 mg/L) at both the background station SW2 and downstream station SW3. Iron was slightly increased downstream during the February and May sampling events. The measured iron concentration was significantly increased from SW2 to SW3 only during the October sampling event which was conducted during a storm event. The landfill contribution to the total iron loading was calculated to be less than 1% during the October event (Table 5-2). The main contributor to the iron will be sediment loading to the creek in this area. This sediment contribution would come from both banks of Redhill Creek. During the low stream flow event on May 6, the landfill contribution was increased to 3.7 % of the total iron loading. During the high flow event on February 19, the landfill contribution was decreased to 0.02 % of the total loading. In summary, the loading calculations on each of these occasions indicate the landfill itself did not cause the exceedances of the PWQO for iron at SW3. The landfill contribution of iron to the creek is insignificant.

- **Nitrogen Compounds**

  The results show that the landfill contribution to the total loading of nitrogen compounds (TKN, total NH3, free NH3 and organic nitrogen) in the creek could be significant during low flow conditions such as on May 6, and October 7, 1998 (Table 5-1). However, even under these conditions, concentrations of the compounds were still very low at SW3. The concentration of free ammonia (un-ionized ammonia), the only nitrogen compound to which the PWQO applies, was below the guideline of 0.02 mg/L at SW3 during most of these monitoring events. Only on February 19, 1998, the free ammonia was increased from 0.016 mg/L at SW2 to 0.03 mg/L at SW3 and slightly exceeded the PWQO at SW3. This 0.03 mg/L found on occasion at SW3 is still very low and the landfill contribution is only 3.7 % of the total loading of free ammonia at SW3. Therefore, the landfill contribution of free ammonia to the creek is insignificant.

- **Total Phosphorus**

  The measured total phosphorus exceeded the PWQO (0.03 mg/L) at both SW2 and SW3 during all the four sampling events in 1998. The measured concentration of total phosphorus was increased from SW2 to SW3 only during the May and October monitoring events. The landfill contribution of phosphorus to the total loading was usually less than 1 % and it could increase on occasion to 6 % during the low stream flow condition on May 6, 1998. It is obvious that the landfill does not cause exceedances of the PWQO for total phosphorus at SW3, and the landfill contribution of phosphorus to the creek is insignificant.

- **Boron**

  The measured boron concentration did not exceed the PWQO (0.2 mg/L) at either SW2 or SW3 during the monitoring events. The landfill contribution to boron in the creek was insignificant, less than 3% in any sampling event.

4.2.3 Discussion

In general, the landfill leachate is not having a significant impact on the water quality in the creek. There are some changes in water quality between the upstream and downstream stations, but only a minor portion of these changes have been attributed to the landfill. The landfill has had some impact on the nutrient loading to the creek (mainly nitrogen species), but this has not caused any consistent exceedances of the Provincial Water Quality Objectives. Free ammonia exceeded the PWQO at SW3 on one sampling event for the first time during the past three monitoring years. The frequency of the PWQO exceedances for free ammonia at SW3 is one exceedance sample versus six compliance samples with free ammonia calculated (about 14 %) during the period from 1996 to 1998. The landfill contribution to the total loading of free ammonia in the creek is insignificant. Other increases occurred for some metals, mainly iron, but again only a minor portion of this change is attributed to the landfill.

As per the recommendations in the 1996-1997 monitoring report, filtered samples from the surface water stations were collected and analyzed for only metals. Detailed results are presented in Appendix C in comparison with the regular unfiltered samples. Table 6 compares iron concentrations between filtered and unfiltered samples for stations SW2 and SW3. The data show that iron in filtered samples was significantly lower than the unfiltered samples. The difference of iron concentration between unfiltered and filtered samples reflects the presence of iron oxides/hydrates and other iron-laden fine sediments in the samples. Iron oxides/hydrates could form soon after iron in the leachate is discharged into the stream. The iron concentration for the two types of samples have been tabulated for each station in Table 6 below.

Table 6. Iron Concentration Between Unfiltered and Filtered Samples (mg/L)

	February 19, 1998		May 6, 1998		July 17/23, 1998		October 7, 1998	
	SW2	SW3	SW2	SW3	SW2	SW3	SW2	SW3
TSS	67	81	16.6	23.8	46.6		8.8	39
Unfiltered	3.51	4.02	0.91	1.1	3.06	2.04	0.42	2.39
Filtered	0.19	0.22	0.06	0.05	0.08	0.07	0.07	0.11
Difference	3.32	3.8	0.85	1.05	2.98	1.97	0.35	2.28

Table 6 shows that the difference of iron concentration and TSS increased from SW2 to SW3 during most sampling events. This suggests that likely both fine sediments and iron oxides/hydrates were increased from SW2 to SW3. The increased iron concentrations at SW3 are attributed in part to the fine sediments. It also demonstrates that the amount of iron sediment in the water is high upstream of the landfill. The increase in dissolved iron concentrations is relatively low.

In conclusion, the landfill leachate only poses a minor impact on the water quality in Redhill Creek, largely due to the dilution factor of the stream flow in the creek. Considering the age of the landfill (from 30 to 40 years), most of the compounds in the landfill have been leached out and the potential for continued contaminating the creek will be declining. There is little potential for increased loadings to the creek with maintenance of the landfill slopes. The recent loading calculations confirm that the landfill is not causing a significant water quality impact. This supports the past recommendation that the collection of the landfill leachate will not significantly improve the water quality in Redhill Creek. The landfill itself does not appear to be the cause of any consistent PWQO exceedances, and therefore, considering the cost to install a leachate collection system, no net benefit would result from collecting this leachate. Monitoring of the creek should continue to ensure the conditions have not changed.

4.3 Subsurface Combustible Gas

A total of 17 gas monitoring events took place during 1998. The results are presented in Appendix D.

Historical monitoring of the landfill has indicated that combustible gas is generated at levels above the lower explosive limit for methane. As a result, the landfill gas monitoring program was put in place. Within the landfill, gas migrates upward and discharges at ground surface as no clay cover has been applied to the landfill. The landfill gas also migrates laterally and discharges through the steep side slopes along the east and south perimeters of the site. As a result, the gas pressure in the landfill is expected to be low and thus the potential for gas migrating off-site is also low.

As in the past, combustible gas with explosive potential was detected consistently over much of 1998 at the two off-site gas monitors (G1 and G2). These are located southwest of the railway possibly within the sewage treatment plant property. As described in Section 3.2, an organic peat layer is present between the fill and the silt till in this area. The elevated gas in the two monitors is likely attributed to the old fill and peat around the two monitors, and not the result of migration from the landfill.

The monitoring data show that elevated combustible gas was detected for the first time at G6 during three monitoring events in April and May of 1998. The gas was not detected at G6 during the remaining gas monitoring events. Elevated combustible gas was also detected at location G3 but only during one monitoring event in August, 1998. No elevated combustible gas was detected in manholes MH4 and MH2 located in the vicinity of monitors G6 and G3. The monitoring data indicate that alarm levels were detected at these locations. Since the alarm levels are set at 10% of the Lower Explosive Limit (LEL), this does not indicate that the gas was present at the LEL. We recommend that in the future, readings report the actual percent LEL at these locations. Continued monitoring is recommended in the winter and spring months to determine if this condition persists. Since locations G1, G2, G3 and G6 are only about 100 m away from the residential area, the access to these monitors by the public should be restricted by fences and locks.

No elevated combustible gas was elevated at any other monitoring locations, including gas monitors G4 and G5, manholes MH1 to MH5, and storm sewers SS1 and SS2, during all the 17 monitoring events. This indicates that the landfill gas has not migrated far from the landfill. Based on this there is no concern related to gas migration to the houses southwest of the landfill. Monitoring of the combustible gas should continue during the future landfill monitoring program.

5. Future Monitoring

Table 7 presents the recommended monitoring program for the site.

Table 7. 1999 Surface and Groundwater Monitoring Program

Stations	Filtered/ Unfiltered	Frequency	Parameter List
SW1, SW2, SW3, SW4, SSW, SSE, SSN, and LS2 if flowing	unfiltered	• 3 times per year (spring, summer, and fall) • One blind duplicate sample from each monitoring event	• Field conductivity, pH, flow, water temperature • Alkalinity, phenolics, TSS, TKN, ammonia, nitrate, nitrite, total P, chloride, DOC • Metals (Ag, Al, B, Ba, Be, Ca, Cd, Cr, Co, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sr, V, Zn) to PWQOs
SW2, SW3, SSW, SSE	unfiltered	• 2 x per year (spring, and summer)	• VOCs (MISA 17)
Staff Gauge/Standpipe			• water level in the creek or in the creek bank
GLL9, GLL8	filtered (except organics)	• 3 times per year as above	• pH, conductivity, alkalinity, COD, DOC, phenolics, TKN, ammonia, nitrate, nitrite, total P, chloride, sulphate, • Metals (see list above) to PWQOs
		• 2 times per year (spring, and summer)	• VOCs (MISA 16 and 17)
All Groundwater and Gas Monitoring Wells		• 3 times per year during sampling event	• Water level measurements
Site Inspection		• Winter, summer and fall - once each season • Spring - monthly during gas monitoring	• inspect remediated seeps for erosion • inspect landfill slopes and Redhill Creek bank for seeps, erosion and slumping • inspect for litter
G1, G2, G3, G4, G5, G6, GLL11, MH1, MH2, MH3, MH4, Mh5, SS1, and SS2		• During frost -once every 2 weeks • After thaw - monthly	• Combustible gas measurements
GLL1, GLL9		• twice per year (winter and summer)	• Combustible gas measurements

5.1 Water Quality Monitoring

We recommend monitoring of the leachate and surface water quality be reduced to three times per year. This monitoring program should be set up to include monitoring during spring (high flow), summer (low flow), fall (high flow). The winter sampling event has been dropped since the area is often under ice cover and the season is not representative of either low or high flow conditions. The results of the monitoring programs from 1996 to 1998 indicate that monitoring of the leachate and surface water quality three times per year will be sufficient to evaluate loading to Redhill Creek during high and low flow conditions.

The parameter list for the surface water stations has been limited to leachate indicator parameters. As a few volatile compounds from BTEX group found in leachate monitor GLL-9 have exceeded the PWQO in 1998, selected surface water stations (SW2, SW3, SSW and SSE) should be sampled and analyzed for organics (only Misa Group #17) in the future programs. A detailed analysis of the leachate, including organics, at GLL9 is recommended twice per year to monitor for changes in leachate quality. The continued analysis of the leachate is recommended to obtain a better understanding of the landfill inputs to Redhill Creek. We have also recommended sampling of GLL8 in addition to GLL 9. Since the leachate seeps LS-1 and LS-3 can no longer be sampled directly, there is little information on leachate quality at the south end of the site. By adding GLL8 to the program, we will have a better understanding of the range in leachate quality.

A staff gauge or ministandpipe should be installed in the creek or in the creek bank to better establish the gradients to the creek. This would aid in getting a better understanding of leachate discharge to the creek through groundwater flow.

5.2 Gas Monitoring

Monitoring of subsurface gas at the locations along the Brampton Street road allowance should continue, specifically during the winter, to provide early warning for any potential threat to the residential subdivision to the southwest of the site. The nests should be maintained and capped and locked at all times to prevent vandalism. If the monitors are damaged, they should be repaired as soon as practical. *In situ* sampling caps should be installed on these monitors to ensure the accumulated gas is tested.

During the winter, monitoring should occur once every two weeks for all gas monitors except GLL1 and GLL9. The frequency should decrease to monthly after the spring thaw. GLL1 and GLL9 should be monitored twice per year to determine long term trends in gas production in the landfill. The future monitoring schedule should be re-evaluated after monitoring through the next winter.

Special attention should be paid to monitors G3 and G6 which had elevated levels in 1998. Actual readings for % LEL should be measured and reported during each monitoring event. If explosive potential is found in any of the two monitors in 1999, the access to the monitor should be restricted by using fences and signs. Monitoring once every two weeks should continue as long as elevated levels are detected in any of the gas monitors along Brampton Street.

Due to potential hazards to public, the restriction to the location of gas monitors G1 and G2 should be well maintained by fences and signs. All gas monitors should be locked at all time.

6. Conclusions and Recommendations

The following conclusions are derived from the findings of this monitoring program:

a) the landfill has posed only a minor impact on the water quality in Red Hill Creek. The results confirm the 1996/1997 report conclusions that no engineering measures are needed for leachate collection and treatment;

b) the landfill gas does not migrate significant distances beneath the Brampton Street road allowance. No gas control measures are recommended for the landfill; and

c) elevated combustible gas was detected in gas monitors G3 and G6. These monitors are located relatively close to the landfill. No combustible gases were detected in monitors further from the landfill.

The following recommendations are provided to address the environmental concerns of the site:

a) surface water and leachate monitoring at the site should continue as per the monitoring program outlined on Table 7. Monitoring should include flow measurements from all inputs to the creek in the landfill area during each sampling event;

b) a staff gauge or ministandpipe should be installed on the west side of the creek to determine seasonal hydraulic gradients towards the creek;

c) restriction of access to gas monitors G1 and G2 should be maintained; and

d) special attention should be paid to monitors G3 and G6 which had elevated combustible gas detected in 1998. Actual readings for % LEL should be measured and reported during each monitoring event. If explosive potential is found in any of the two monitors in 1999, the access to the monitor should be restricted by using fences and signs.

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Appendix A

Borehole Logs

GRAPHICS, SYMBOLS AND ABBREVIATIONS ON LOGS

SAMPLE TYPES and TESTS

SS	Split Spoon Sample	
SN	Non-Standard Split Spoon Sample	
ST	Shelby Tube Sample : (unconfined compression or unconsolidated undrained test)	- ◆
DS	Denision Type Sample	
PS	Piston Type Sample	
CS	Continuous Sample	
GS	Grab Sample	
WS	Wash Sample	
BQ	BQ Core Sample	
HQ	HQ Core Sample	
NQ	NQ Core Sample	
DT	Dynamic Penetration Test	
VT	Field Vane Test (undisturbed)	- +
VT	Field Vane Test (remoulded)	- ⊕

PENETRATION RESISTANCES

Standard Penetration Resistance(N Value)

The number of blows by a 63.6 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split spoon sampler for a distance of 300 mm (12 in.).

ABBREVIATIONS

DTPL: Drier Than Plastic Limit
APL: About Plastic Limit
WTPL: Wetter Than Plasic Limit
K: Hydraulic Conductivity (m/s)
C_u: Undrained Shear Strength (kPa)
% REC : Percentage of Sample Recovered
% RQD : Indirect Measure of the Number of Fractures and Soundness of Rock Mass
Approximate Water Table

GRAIN SIZE CLASSIFICATION

	%
trace, "eg. trace sand"	1 - 10
some, "eg. some sand"	10 - 20
adjective, "eg. sandy"	20 - 35
and, "eg. and sand"	35 - 50
noun, "eg. sand"	>50

Note: Classification Divisions Based on Modified M.I.T. Grain Size Scale

SOIL DESCRIPTIONS

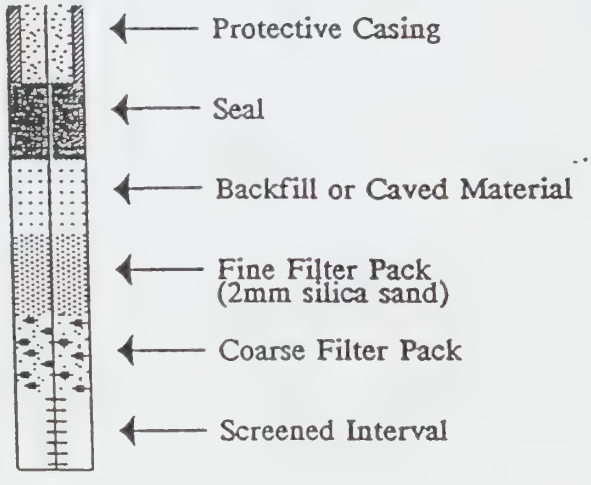
Cohesionless Soils

Relative Density	N Value
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	over 50

Cohesive Soils

Consistency	C_u(kPa)	N Value
Very soft	0 to 12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	over 200	over 30

MONITOR DETAILS



BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 1 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 17 November 1995
GEOLOGIST BJS
ELEVATION 83.75 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
0		**FILL** Dark red to dark brown silt with some clay, trace fine sand and medium gravel, trace wood fragments, moist, compact		1		SS	14		60		
1				2		SS	30		75		
		Same as above, black asphalt fragments found at the bottom of sample, the clayey silt turning to olive grey at about 2.0 m		3		SS	25		85		
2											
3		Mottled brownish grey clayey silt, trace gravel and fine sand, turning grey at 3.7 m, WTPL		4		SS	6		80		
3.8		**ORGANIC PEAT** Black organic peat sludge with rootlets and trace clayey silt, wet and organic odour		5		SS	3		100		
4											
4.7		**SILT TILL** light brown silt with some clay, trace fine sand, some grey and yellow mottling, lots of rootlets moist, dense		6		SS	34		90		
5				7		SS	38		100		
		light brown silt, some clay, trace fine sand and coarse gravel, 1 cm thick red sand seam at 6.0 m, moist, dense		8		SS	38		100		
6				9		SS	58		100		
		Red silt, some fine sand and gravel, trace clay and coarse sand, moist, very dense		10		SS	174		100		
7				11		SS	118/0.15m		100		
8				12		SS	258/0.15m		100		
8.5		Borehole Terminated at 8.53 m in silt till.									

Printed: 27 MAR 97

Gartner Lee Limited

BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 2 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 20 November 1995
GEOLOGIST BJS
ELEVATION 85.1 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
		FILL									
1											
		Dark brown silty fine sand with some medium sand and gravel, some slag, saturated		1		SS	34		100		
2											
3		Redish brown and some grey clayey silt with trace fine sand and gravel, wet		2		SS	40		75		
4											
4.7				3		SS	63		100		
		SILT TILL									
5		Greyish brown silt with trace fine to coarse sand and gravel fragments, vertical fractures filled with clay, laminations observed, saturated, very dense									
5.4				4		SS	54/0.07m		100		
		Borehole terminated at 5.4 m in silt till.									

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BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 3 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 20 November 1995
GEOLOGIST BJS
ELEVATION m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
1		**FILL**									
		Red silt with some clay, trace fine to coarse sand and gravel, moist		1		SS	16		30		
2											
3		3.05 - 3.5 m, red silt with grey clayey silt nodules, trace fine sand and gravel, moist 3.5 - 3.66 m, brown and black silt with some clay and gravel, moist		2		SS	23		75		
3.8		**SILT TILL**		3		SS	15		30		
4		Greenish brown clayey silt to silt with some clay, trace gravel and fine sand, vertical fracturing, some clay infilling in fractures, moist		4		SS	57		100		
5		Brown silt, with some clay and trace fine sand, moist, some yellow mottling		5		SS	64		100		
5.9		Borehole terminated at 5.94 m in silt till.									

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BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 4 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 20 November 1995
GEOLOGIST BJS
ELEVATION m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
1		**FILL** 1.52 - 1.62 m, Red clayey silt with grey clayey silt nodules, trace fine sand, wet 1.62 - 1.72 m, Red coarse sand 1.72 - 2.13 m, Yellow brown fine sand, saturated 2.13 - 2.7 m, yellowish brown clayey silt with sand and gravel		1		SS	4		80		
2				2		SS	19		100		
2.7		**SILT TILL** Brownish grey silt, trace fine sand and gravel, vertical fractures filled with clay, wet, rootlets									
3				3		SS	37		100		
4				4		SS	30		100		
4.4		Borehole terminated at 4.42 m in silt till									

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Gartner Lee Limited

BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 5 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 21 November 1995
GEOLOGIST BJS, SRB
ELEVATION 87.93 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	N VALUE	% WATER	% REC	% RQD	COMMENTS
1		**FILL** Red silt with trace sand and clay, some grey dolostone fragments, trace brick and asphalt, wet		1		SS	4		75		
3		Redish brown silt, some clay and fine to coarse sand and gravel, moist, compact		2		SS	19		70		
4		Greenish grey clayey silt with trace fine sand and gravel, moist		3		SS	22		85		
6		Greyish brown clayey silt, mottled orange, red, brown and grey, trace fine sand and gravel, horizontal and vertical fracturing, trace asphalt and brick fragments, wet, compact to dense		4		SS	10		85		
7				5		SS	23		75		
8		7.93 - 8.23 m, refuse (tile, chipboard, timber, plastic, aluminum)		6		SS	32		50		
10		Red silt with some clay, and some fine sand, gravel and shale nodules, a thin layer of refuse, moist, compact		7		SS	20		60		
11		Red shale and grey dolostone rubbles, moist, very dense		8		SS	38		50		
12		Layered red shale, grey shale at 12.4 to 12.5 m, saturated, very dense		9		SS	39		100		
13.3		**SILT TILL** Grey clayey silt to silt with some clay, some shale fragments and rotten rootlets, firm, WTPL		10		SS	21		100		
14		Grey silt with some clay, rotten rootlets, saturated, compact		11		SS	24		100		
14.9		Borehole terminated at 14.94 m in silt till									

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Gartner Lee Limited

BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 6 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 21 November 1995
GEOLOGIST SRB
ELEVATION m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
		FILL Red silt, with some clay and black fine sand at 0.3 m and red shale fragments, trace fine sand and gravel, with rootlets, moist, compact		1		SS	12		100		
				2		SS	18		100		
1.0		**SILT TILL** Red silt to clayey silt, trace fine sand and gravel, wet, compact, lots of rotted rootlets		3		SS	13		100		
1											
		Grey clayey silt, numerous rootlets, trace fine sand and gravel, WTPL, soft		4		SS	5		100		
2											
		Grey silt, some peat-like clay, some rootlets, saturated		5		SS	4		100		
2.8		Borehole terminated at 2.81 m in silt till									

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Gartner Lee Limited

BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 7 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 22 November 1995
GEOLOGIST BJS
ELEVATION 85.03 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
0		**FILL** Dark brown and black silt, sand and gravel with some clayey silt, saturated, dense									
2.7		**SILT TILL** 3.05 - 3.3 m, red silt , some sand and shale fragments, trace clay, moist 3.3 - 3.66 m, brownish grey clayey silt, trace fine sand and gravel, fracturing, and rootlets in fractures, DTPL		1		SS	15		100		
		Light brown silt with trace fine sand and gravel, moist, very dense		2		SS	82		100		
		Reddish brown silt, trace to some fine sand and gravel, very dense, wet to saturated		3		SS	120/0.15m		100		
		Reddish brown silt, trace fine sand and gravel, wet to saturated, very dense		4		SS	70/0.15m		100		
9.2		**SHALE** Red shale (Queenston Shale), with occasional mud stone layers, numerous horizontal fractures and some vertical fracturing		5		SS	>50/0.1m		100	40	
				6		HQ			80		
				7		HQ			100	18	
11.5		Borehole terminated at 11.47 m in shale bedrock									

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Gartner Lee Limited

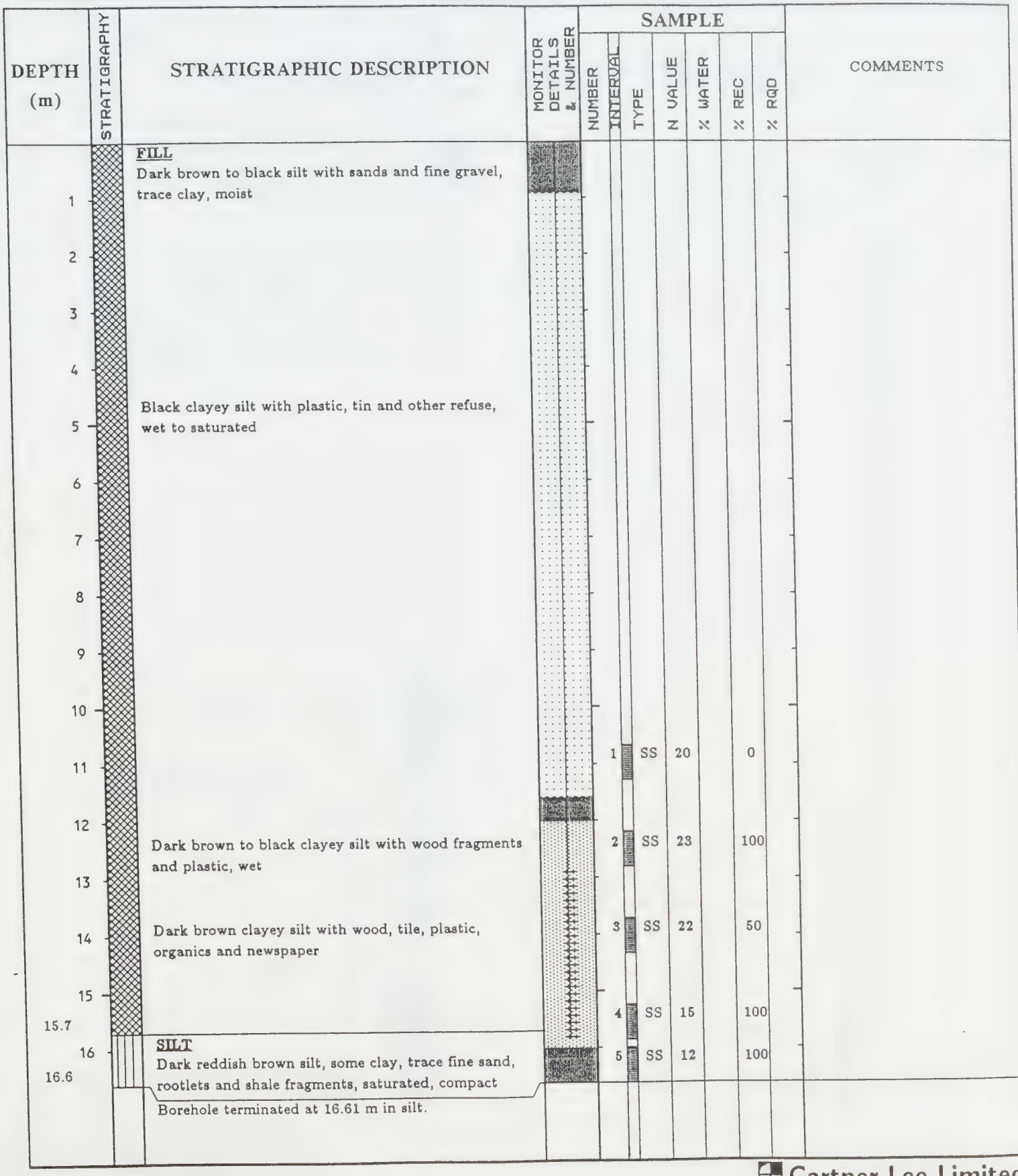
BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 8 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 22 November 1995
GEOLOGIST BJS
ELEVATION 89.36 m ASL


DEPTH (m)
STRATIGRAPHY
STRATIGRAPHIC DESCRIPTION
MONITOR DETAILS & NUMBER
SAMPLE
NUMBER
INTERVAL
TYPE
N VALUE
% WATER
% REC
% RQD
COMMENTS
FILL
Dark brown to black silt with sands and fine gravel, trace clay, moist
Black clayey silt with plastic, tin and other refuse, wet to saturated
Dark brown to black clayey silt with wood fragments and plastic, wet
Dark brown clayey silt with wood, tile, plastic, organics and newspaper
15.7
SILT
Dark reddish brown silt, some clay, trace fine sand, rootlets and shale fragments, saturated, compact
16.6
Borehole terminated at 16.61 m in silt.
1 SS 20 0
2 SS 23 100
3 SS 22 50
4 SS 15 100
5 SS 12 100

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Gartner Lee Limited

BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 9 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 23 November 1995
GEOLOGIST BJS
ELEVATION 86.87 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
1		**FILL** Brown and black silt and clayey silt with fine to medium sand, some gravel, plastic, wood fragments, and aluminum, wet									
2											
3											
4											
5											
6											
7											
8											
9		Same as above, oily sheen observed on sample, saturated		1		SS	15		50		
10											
11		Reddish brown silt, trace fine sand and clay and gravel, rootlets, trace shells and wood fragments, saturated, compact		2		SS	19		100		
		Brown silt with some clay, fine red shale fragments, rotted rootlets, some black organic material, WTPL		3		SS	13		80		
12		Reddish brown silt with some clay, rotted rootlets, trace fine sand and gravel, WTPL, hard		4		SS	16		100		
13				5		SS	20		100		
14		Reddish brown clayey silt changing to silt, some fine sand, trace fine gravel and wood fragments, rotted rootlets, a piece of tin, orange mottling, some organic staining, saturated, loose		6		SS	33		100		
15.1 15				7		SS	5		100		
		Borehole terminated at 15.09 m in fill.									

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BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 10 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 27 November 1995
GEOLOGIST BJS
ELEVATION 82.24 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
0		**FILL** Reddish brown silt, trace clay and fine sand, trace gravel and rootlets, moist and loose									
1				1		SS	6		50		
2		1.62 - 2.13 m, dark brown to black organic silt, organic odour, moist to wet		2		SS	9		80		
2.6		Mottled red and black silt, trace fine sand, gravel and organics									
3		**PEAT** Dark brown to black organic silt with some rootlets, organic odour, wet, loose		3		SS	4		80		
4				4		SS	5		0		
5		Brown to black peat, some silt and sands, wet, organic odour		5		SS	3		85		
6				6		SS	4		85		
7											
7.6		**SILT** Dark brown silt, some clay mottled, trace fine sand and gravel, blocky, some rootlets, wet to saturated		7		SS	6		100		
8				8		SS	14		100		
9.2	9	**SANDY SILT TILL** Medium brown silt to sandy silt, trace clay, wet, very dense		9		SS	>50		100		
10		Red sandy silt, some fine gravel and trace clay, wet to saturated		10		SS	>50/ 0.15m		90		
11				11		SS	>50/ 0.15m		50		
12				12		SS	77/ 0.07m		100		
13											
13.8		Medium brown sandy silt, trace clay and fine to medium gravel, some shale fragments, saturated, very dense		13		SS	>100/ 0.07m		100		
		Borehole terminated at 13.79 m in sandy silt till.									

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BOREHOLE LOG

PROJECT: 95-331

BOREHOLE: GLL 11 1 of 1

Hydrogeological Investigation
Brampton Street Landfill, Hamilton, Ontario
FOR: Regional Municipality of Hamilton-Wentworth

DATE: 27 November 1995
GEOLOGIST BJS
ELEVATION 83.4 m ASL

DEPTH (m)	STRATIGRAPHY	STRATIGRAPHIC DESCRIPTION	MONITOR DETAILS & NUMBER	SAMPLE NUMBER	SAMPLE INTERVAL	SAMPLE TYPE	SAMPLE N VALUE	SAMPLE % WATER	SAMPLE % REC	SAMPLE % RQD	COMMENTS
0		**SILT** Reddish brown silt, some clay, trace sands with rootlets, moist		1		SS	13		70		
1				2		SS	3		30		
2.1		**PEAT** Black organic silt, fibrous and odourous, wet		3		SS	4		100		
3.7		**SILT** Red silt with some grey silt banding, some shale particles and silt nodules, trace sand, wet, compact		4		SS	19		100		
6.1		**SHALE** Red shale with grey banding, weathered with numerous horizontal fractures		5		HQ			100	29	
7.9		Borehole terminated at 7.92 m in shale									

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Appendix B

Groundwater Level and
Groundwater Quality Data

Appendix B: Water Level Data - Closed Brampton Street Landfill

Monitor No	Monitor Depth (mBGL)	Stickup of Pipe (mAGL)	Monitor Total Depth (mBTOP)	Ground Elevation (mASL)	TOP Elevation (mASL)	Monitoring Date	Water Level Depth (mBTOP)	Ground Water Elevation (mASL)
GLL 1	5.18	0.72	5.9	83.75	84.47	13-Dec-95	<5.92	< 78.55
						24-May-96	5.62	78.85
						05-Sep-97	3.28	81.19
						22-Jul-98	3.33	81.14
						18-Aug-98	3.32	81 15
						09-Sep-98	3.3	81.17
						05-Oct-98	3.33	81.14
						04-Nov-98	3.58	80.89
						19-Nov-98	3.52	80.95
						08-Dec-98	3.64	80.83
GLL 2	2.79	0.68	3.47	85.1	85.78	13-Dec-95	1.63	84.15
						24-May-96	0.6	85.18
						05-Sep-97	2.26	83.52
						22-Jul-98	2.12	83.66
						18-Aug-98	2.25	83.53
						09-Sep-98	2.33	83.45
						05-Oct-98	2.44	83.34
						04-Nov-98	2.49	83.29
						19-Nov-98	2.97	82.81
						08-Dec-98	2.8	82.98
GLL 5	13.75	0.72	14.47	87.93	88.65	13-Dec-95	12.3	76.35
						24-May-96	11.88	76.77
						05-Sep-97	12.62	76.03
						22-Jul-98		
						18-Aug-98	12.82	75.83
						09-Sep-98	12.87	75.78
						05-Oct-98	12.93	75.72
						04-Nov-98	12.75	75.9
						19-Nov-98	13.98	74.67
						08-Dec-98	13.07	75.58
GLL 7	11.47	0.69	12.16	85.03	85.72	13-Dec-95	8.39	77.33
						24-May-96	8.25	77.47
						05-Sep-97	8.65	77.07
						22-Jul-98	8.6	77.12
						18-Aug-98	8.74	76.98
						09-Sep-98	8.7	77.02
						05-Oct-98	8.87	76.85
						04-Nov-98	8.92	76.8
						19-Nov-98	8.88	76.84
						08-Dec-98	8.9	76.82
GLL 8	16	0.86	16.86	89.36	90.22	13-Dec-95	11.76	78.46
						24-May-96		
						05-Sep-97	11.01	79.21
						22-Jul-98		
						18-Aug-98	11.07	79.15
						09-Sep-98	11.08	79.14
						05-Oct-98	11.24	78.98
						04-Nov-98	11.34	78.88
						19-Nov-98	11.2	79.02
						08-Dec-98	11.39	78.83

Appendix B: Water Level Data - Closed Brampton Street Landfill

Monitor No	Monitor Depth (mBGL)	Stickup of Pipe (mAGL)	Monitor Total Depth (mBTOP)	Ground Elevation (mASL)	TOP Elevation (mASL)	Monitoring Date	Water Level Depth (mBTOP)	Ground Water Elevation (mASL)
GLL 9	13.41	0.8	14.21	86.87	87.67	13-Dec-95	7.63	80.04
						24-May-96	7.33	80.34
						05-Sep-97	6.76	80.91
						22-Jul-98	6.64	81.03
						18-Aug-98	6.77	80.9
						09-Sep-98	6.84	80.83
						05-Oct-98	7.09	80.58
						04-Nov-98	6.98	80.69
						19-Nov-98	6.93	80.74
						08-Dec-98	7.02	80.65
GLL 10	12.8	0.63	13.43	82.24	82.87	13-Dec-95	4.01	78.86
						24-May-96	3.89	78.98
						05-Sep-97	4.04	78.83
						22-Jul-98		
						18-Aug-98	4.12	78.75
						09-Sep-98	4.11	78.76
						05-Oct-98	4.25	78.62
						04-Nov-98	4.27	78.6
						19-Nov-98	4.32	78.55
						08-Dec-98	4.36	78.51
GLL 11	7.92	0.78	8.7	83.4	84.18	13-Dec-95	5.07	79.11
						24-May-96	4.71	79.47
						05-Sep-97	5.08	79.1
						22-Jul-98	5.27	78.91
						18-Aug-98	5.31	78.87
						09-Sep-98	5.35	78.83
						05-Oct-98	5.4	78.78
						04-Nov-98	5.46	78.72
						19-Nov-98	5.47	78.71
						08-Dec-98	5.66	78.52
0W3	5.67	0.83	6.5	78.81	79.64	13-Dec-95	1.5	78.14
						24-May-96		
						05-Sep-97	3.76	75.88
						22-Jul-98	3.51	76.13
						18-Aug-98	3.98	75.66
						09-Sep-98	4.14	75.5
						05-Oct-98	4.55	75.09
						04-Nov-98	4.62	75.02
						19-Nov-98	5.14	74.5
						08-Dec-98	5.45	74.19
AU94-3	1.38	1.07	2.45	75.38	76.45	13-Dec-95	1.63	74.82
						24-May-96		
						05-Sep-97	1.61	74.84
						22-Jul-98	1.48	74.97
						18-Aug-98	1.69	74.76
						09-Sep-98	1.97	74.48
						05-Oct-98	2.24	74.21
						04-Nov-98	2.27	74.18
						19-Nov-98	2.3	74.15
						08-Dec-98	2.29	74.16

Appendix B: Water Level Data - Closed Brampton Street Landfill

Monitor No	Monitor Depth (mBGL)	Stickup of Pipe = (mAGL)	Monitor Total Depth (mBTOP)	Ground Elevation (mASL)	TOP Elevation (mASL)	Monitoring Date	Water Level Depth (mBTOP)	Ground Water Elevation (mASL)
TP94-1	2.89	0.89	3.78	77.37	78.26	13-Dec-95	1.19	77.07
						24-May-96		
						05-Sep-97	1.42	76.84
						22-Jul-98	1.19	77.07
						18-Aug-98	1.43	76.83
						09-Sep-98	1.46	76.8
						05-Oct-98	1.49	76.77
						04-Nov-98	1.51	76.75
						19-Nov-98	1.81	76.45
						08-Dec-98	1.62	76.64
G1						24-May-96	3.95	
						22-Jul-98	5.27	
						18-Aug-98	5.16	
						09-Sep-98	5.12	
						05-Oct-98	5.18	
						04-Nov-98	5.29	
						19-Nov-98	4.95	
						08-Dec-98	5.48	
G2						24-May-96	5.54	
						22-Jul-98	4.17	
						18-Aug-98	4.45	
						09-Sep-98	4.4	
						05-Oct-98	4.64	
						04-Nov-98	4.82	
						19-Nov-98	4.8	
						08-Dec-98	4.84	
G3						22-Jul-98	3.5	
						18-Aug-98	3.63	
						09-Sep-98	3.73	
						05-Oct-98	3.84	
						04-Nov-98	4	
						19-Nov-98	4.1	
						08-Dec-98	4.17	
G4						22-Jul-98		
						18-Aug-98	dry	
						09-Sep-98	dry	
						05-Oct-98	dry	
						04-Nov-98	dry	
						19-Nov-98	dry	
						08-Dec-98	dry	
G5						22-Jul-98	3.04	
						18-Aug-98	3.32	
						09-Sep-98	3.4	
						05-Oct-98	3.52	
						04-Nov-98	3.57	
						19-Nov-98	3.16	
						08-Dec-98	3.66	
G6						22-Jul-98		
						18-Aug-98		
						09-Sep-98	2.94	
						05-Oct-98	2.94	
						04-Nov-98	3.2	
						19-Nov-98	2.95	
						08-Dec-98	3.1	

mASL - metre above sea level; mAGL - metre above ground level; mBGL - metre below ground level
mBTOP - metre below top of pipe; TOP - top of pipe

Appendix B: Ground Water Quality Data

Closed Brampton Street Landfill Site

ANALYTICAL PARAMETERS			ODWO	GLL 9							GLL 11				
				05-Jun-96	21-Aug-96	07-Jul-97	19-Feb-98	06-May-98 Unfiltered	17-Jul-98 Unfiltered	08-Oct-98	05-Jun-96	06-Jun-96 Field Dupl.	21-Aug-96	21-Aug-96 Field Dupl.	07-Jul-97
General Parameters															
pH (Field)				7.3	6 88		7 87	7.73	7 94	7.91	7.2	7.2	6.88	6.88	
Conductivity (Field)		us/cm			1970		7700	7840	8230	8480	1571	1571	1970	1970	
pH (Lab)												7.38		7.21	
Alkalinity		mg/L		2080	659	2380	2390	2600	2430	2460	629	612.3	659	650	667
Sodium	Na	mg/L	200*	473	107	296	716	746	740	715	108	110	107	0.87	105
Calcium	Ca	mg/L		212	257	15 6	62	46 3	44 5	51.7	256	244	257	52	256
Magnesium	Mg	mg/L		180	72 3	41	112	102	96 2	102	70	63.2	72.3	19	69
Potassium	K	mg/L		130	4 3	136	275	311	280	289	6.3	6.84	4.3	1.1	3 7
Chloride	CL	mg/L	250*	1340	201	1320	1360	1360	1180	1250	173	164	201	190	189
Nitrate	NO3	mg/L	10	0.049	<0 01	0.141	<0.025	0 17	<0.03	<0 03	0.025	<0.01	<0.023	<0.05	<0 005
Nitrite	NO2	mg/L	1	0.009	0 01	0 012	<0 12	<0 10	<0 03	<0.03	0.005	<0.2	0.01	<0.05	<0 005
Ammonia	NH3	mg/L		352	<0 01	485	504	530	499	458	<0.1	0.61	<0.1	<0.03	<0 1
Total Kjeldahl Nitrogen	TKN	mg/L		386	<0 01	495	519	530	554	577	1.5	0.90	<0.6	0.83	<0 6
Organic Nitrogen		mg/L		34		10	15	0	55	119	1.5	0.29	<0.6	0.83	
Phenols		mg/L		0.048	<0.01	0 009	0.011	0 006	0.004	0.008	0.024	<0.0005	<0.002	<0.001	<0 003
Total Phosphorus	P	mg/L			NR	0.502	1.12	1 72**	1 34**			0.01		0.085	0 05
Chemical Oxygen Demand	COD	mg/L		1040	57	1040	1270	1170	1280	1320	66	43	57	1100	62
Biological Oxygen Demand	BOD	mg/L		52	nd						<3	0.8	<2		
Dissolved Organic Carbon	DOC	mg/L	5*	280	11	400	314	320	222	307	13	12.4	11	12	9 1
Sulphate	SO4	mg/L	500*	15	308	<10	<10	28	<10	<10	295	331	308	300	293
Ortho Phosphorus	PO4	mg/L		0.098	0 052					10.7	0.034	0.003	0.052		
Total Dissolved Solid	TDS	mg/L	500*	3370	1160						1270		1160		
Trace Metals															
Aluminum	Al	mg/L	0.1**	0.52	0.089	0.57	0.2	0.1	1	<0.05	0.22	0.021	0.089	1.9	<0 05
Beryllium	Be	mg/L		<0.01	<0.001	0.0002	0 0007	0.0003	0.946	0.0004	<0.01	<0.001	<0.001	<0.001	0 0001
Cadmium	Cd	mg/L	0.005	0.0003	0.0006	0 003	<0.001	<0.001	0.87	<0.0006	0.001	<0.0001	0.0006	<0.002	0 0006
Chromium	Cr	mg/L	0.05	<0.04	<0.004	0.01	0.006	0.009	1.74	0.013	<0.04	0.012	<0.004	0.051	0 0006
Cobalt	Co	mg/L		0.06	0 02	0.028	0.056		0.92	0.0506	<0.005	0.0013	0.02	<0.01	<0 001
Copper	Cu	mg/L	1*	0.01	0.008	0.003	0.018	<0.004	1.87	0.006	0.01	0.0024	0.008	0.077	0.0006
Nickel	Ni	mg/L		0.05	0.026	0.111	0.129	0.13	1.83	0.122	<0.03	0.014	0.026	0.16	0 016
Lead	Pb	mg/L	0.01	<0.005	0 038	<0.005	0.006	0.009	<0.005	0.008	<0.005	<0.0005	0.038	0.051	<0.005
Zinc	Zn	mg/L	5*	0.08	0 07	0.003	0.027	0.02	1.88	0.07	0.07	0.002	0.07	0.45	0.0405
Silver	Ag	mg/L		<0.001	<0 001	<0.02	<0.001	<0 004	0.177	<0.002	<0.001	<0.00005	<0.001	<0.01	<0 004
Molybdenum	Mo	mg/L		<0.05	<0.005	<0 02	<0.008	0 008	0.013	0.009	<0.05	0.004	<0.005	0.038	<0 004
Vanadium	V	mg/L		0.016	0.006	0.003	0.399	0.35	0.97	0.009	0.011	0.0043	0.006	0.017	0.0006
Iron	Fe	mg/L	0.3*	15.7	0.15	1.89	1.66	1.32	3.45	1.14	1.56	0.27	0.15	8.8	0 162
Manganese	Mn	mg/L	0.05*	1.44	0 92	0 114	0.17				1.15	1.09	0.92	0.35	1 03
Strontium	Sr	mg/L		2.72	0.92	0.643		0.66	2.4	0.77	1.18	1.38	0.92	0.064	0.774
Barium	Ba	mg/L	1	2.08	0.16	0.363		0.564	2.39	0.692	0.11	0.092	0.16	0.17	0 04
Boron	B	mg/L	5	0.91	0.47	1.7		1.6	1.6	1.6	1	1.06	0.47	0.026	0.3

Notes: ODWO - Ontario Drinking Water Objectives, health related parameters (Revised 1994);

* - aesthetic parameters

** - dissolved phosphorous, sample filtered

Appendix B: Ground Water Quality Data

Closed Brampton Street Landfill Site

ANALYTICAL PARAMETERS			ODWO	Leachate Seep LS-1							Leachate Seep LS-3	
				05-Jun-96	21-Aug-96	21-Nov-96	12-Mar-97	07-Jul-97	19-Feb-98	06-May-98	19-Feb-98	06-May-98
General Parameters												
pH (Field)				7.4	6.68				7.31	7.32	7.95	7 79
Conductivity (Field)		us/cm		4990	12530				5180	6780	3750	6700
pH (Lab)												
Alkalinity		mg/L		644	320	655	560	485	540	697	635	796
Sodium	Na	mg/L	200*	1210	2260	2080	1300	1680	813	1230	545	1090
Calcium	Ca	mg/L		239	263	252	246	227	169	264	113	461
Magnesium	Mg	mg/L		73.6	80	80	73.8	75	57.8	68 2	119	101
Potassium	K	mg/L		19.6	24.8	25.6	22.2	21.2	19.4	23	41 9	45
Chloride	CL	mg/L	250*	2760	4060	3870	2400	2690	1460	1950	830	1880
Nitrate	NO3	mg/L	10	0.15	0.021	0.168	0.556	0.095	1.74	<0 10	0.463	<0 10
Nitrite	NO2	mg/L	1	0.011	0.012	0.016	0.018	0.011	<0.06	<0 10	<0 06	<0 10
Ammonia	NH3	mg/L		23.3	34.5	34.6	18.7	25	14 4	19 4	33.4	39 3
Total Kjeldahl Nitrogen	TKN	mg/L		27	34.8	35.6	20.7	26	15.6	44.4	35.1	49 7
Organic Nitrogen		mg/L		3.7	0.3	1	2	1	1.2	25	1.7	10.4
Phenols		mg/L		0.01	0.002	0.012	0.003	0 003	0 033	0 036	0 003	0 006
Total Phosphorus	P	mg/L		0.71		0.034		<0.024	0 64	10 8	0 107	1 1
Chemical Oxygen Demand	COD	mg/L		170	142	181	47	512				
Biological Oxygen Demand	BOD	mg/L		6	<2	<4						
Dissolved Organic Carbon	DOC	mg/L	5*	17	12	11	13	20.1				
Sulphate	SO4	mg/L	500*	72	49	17	134	77				
Ortho Phosphorus	PO4	mg/L		0.051	0.037		<0.024					
Total Dissolved Solid	TDS	mg/L	500*	4900	6990							
Trace Metals												
Aluminum	Al	mg/L	0.1**	0.29	0.053	0.036	0.02	0.09	0.99	6 7	0.55	1 24
Beryllium	Be	mg/L		<0.01	0.001	<0.01	<0.01	0.0002	0.0003	0.0004	0.0006	0 0005
Cadmium	Cd	mg/L	0.005	0.0004	0.0003	0.0002	0.0001	0.0012	0.0013	0.013	<0.0006	
Chromium	Cr	mg/L	0.05	<0.04	<0.004	0.006	<0.002	0.0012	0.077	0.456	<0.001	<0 001
Cobalt	Co	mg/L		0.05	0.043	<0.005	<0.005	<0.002	0.001		0.002	
Copper	Cu	mg/L	1*	0.03	0.022	0.05	0.162	0.0012	0.007	0.06	0.011	<0 002
Nickel	Ni	mg/L		<0.03	0.057	0.005	0.034	0.022	0 028	0.056	0.022	0 02
Lead	Pb	mg/L	0.01	0.007	0.073	0.12	<0.005	<0.005	0.006	0.15	<0.005	0 006
Zinc	Zn	mg/L	5*	0.16	0.13	0.07	0.1	0.0271	0.195	0.77	0.147	0 04
Silver	Ag	mg/L		<0.001	<0.001	<0.001	<0.03	<0.008	<0 001	<0.004	<0.001	<0 002
Molybdenum	Mo	mg/L		<0.05	0.005	<0.01	<0 01	<0.008	<0 004	<0 008	0 008	0 012
Vanadium	V	mg/L		0.011	<0.005	0.018	0.013	0 0012	0 211	0 27	0.429	0 329
Iron	Fe	mg/L	0.3*	34	0.15	0.48	0.35	1.52	51	323	1.98	4 31
Manganese	Mn	mg/L	0.05*	0.71	0.76	0.67	0.55	0.58	0 566		0.423	
Strontium	Sr	mg/L		2.01	2.61	2.81	1.94	2.14		1.94		1 44
Barium	Ba	mg/L	1	1.1	1.6	1.8	0.83	0.917	0 979	3	0.261	0 547
Boron	B	mg/L	5	0.48	0.53	0.58	0.52	0 55		0 66		1 2

Notes: ODWO - Ontario Drinking Water Objectives, health related parameters (Revised 1994);
* - aesthetic parameters
** - dissolved phosphorous, sample filtered

Appendix B: Ground Water Sample
Volatile Organics Analysis Results

Volatile Organic Compound	ODWO	Limit of Quantitation			Leachate Seep LS-1			GLL 9			
		Regional Lab	Barringer Lab	Zenon Lab	05-Jun-96	21-Aug-96	13-Mar-97	05-Jun-96	07-May-98	23-Jul-98	08-Oct-98
					Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab
	(ug/L)	(ug/L)	(ug/L)	(ug/L)	DF=1	DF=1		DF=10			
MISA Analytical Test Group #16 (Halogenated Volatiles)											
Chloromethane		5.1	1.0	2.3	ND		ND	ND	ND	ND	ND
Vinyl Chloride	2	6.6	1.0	2.9	ND		ND	ND	ND	ND	ND
Bromomethane		1.5	1.0	2.4	ND		ND	ND	ND	ND	ND
Trichlorofluoromethane		1.3	0.5	0.3	ND		ND	ND	ND	ND	ND
1,1-Dichloroethylene		0.4	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	50	1.2	1.0	0.3	ND	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene		0.8	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane		0.2	0.2	0.5	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene		1.0			8.3	4.7	8.4	ND	ND	ND	ND
Chloroform		0.2	0.2	0.4	0.2	ND	ND	2	ND	ND	ND
Carbon Tetrachloride	5	0.2	0.2	0.3	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	5	0.4	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	50	0.3	0.2	0.3	0.6	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane		0.2	0.2	0.5	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane		0.2	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropylene		0.2	0.2	0.7	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropylene		0.2	0.2	1.1	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane		0.2	0.2	0.6	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene		0.2	0.2	0.2	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane		0.3	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
Ethylene Dibromide		0.2	0.2	0.6	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	80	0.2	0.2	0.6	0.9	0.5	0.3	4	4.5	4.2	6
Bromoform		0.2	0.5	0.3	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane		0.2	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene		0.2	0.2	0.3	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	5	0.2	0.2	0.2	0.4	0.5	0.2	2	11.1	ND	13
1,2-Dichlorobenzene	200	0.2	0.2	0.4	ND	ND	ND	ND	1	ND	ND
MISA Analytical Test Group #17 (Non-Halogenated Volatiles)											
Benzene	5	0.2	0.1	0.2	0.5	ND	0.2	3	2.9	2.9	4
Toluene	24*	0.2	0.2	0.4	ND	ND	ND	ND	2.6	2.6	3
Ethylbenzene	2.4*	0.2	0.2	0.4	ND	ND	ND	6	24.1	21.1	31
m & p-Xylenes	300**	0.2	0.2	0.5	ND	ND	ND	5	34.5	24.8	42
o-Xylene		0.2	0.2	0.4	ND	ND	ND	4	24.8	20.7	29
Styrene		0.2	0.2	0.4	ND	ND	ND	ND	0.7	ND	ND

Notes: ODWO - Ontario Drinking Water Objectives, health related parameters (July 1994); DF = Dilution Factor; * - aesthetic parameters; ** - ODWO for total Xylenes

Appendix B: Ground Water Sample
Volatile Organics Analysis Results

Volatile Organic Compound	ODWO	Limit of Quantitation			GLL 11				
		Regional Lab	Barringer Lab	Zenon Lab	05-Jun-96	05-Jun-96	05-Jun-96	21-Aug-96	21-Aug-96
					Regional	Barringer Field Dupl.	Barringer Lab Dupl.	Regional	Zenon Lab Field Dupl.
	(ug/L)	(ug/L)	(ug/L)	(ug/L)	DF=10	DF=200	DF=200	DF=10	DF=1
MISA Analytical Test Group #16 (Halogenated Volatiles)									
Chloromethane		5.1	1.0	2.3	ND	ND	ND	ND	ND
Vinyl Chloride	2	6.6	1.0	2.9	192	ND	ND	trace	290
Bromomethane		1.5	1.0	2.4	ND	ND	ND	ND	ND
Trichlorofluoromethane		1.3	0.5	0.3	ND	ND	ND	ND	ND
1,1-Dichloroethylene		0.4	0.2	0.4	ND	ND	ND	ND	4.2
Methylene Chloride	50	1.2	1.0	0.3	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene		0.8	0.2	0.4	ND	ND	ND	ND	6.3
1,1-Dichloroethane		0.2	0.2	0.5	ND	ND	ND	ND	0.6
cis-1,2-Dichloroethylene		1.0			1270			1290	
Chloroform		0.2	0.2	0.4	ND	ND	ND	4	ND
Carbon Tetrachloride	5	0.2	0.2	0.3	ND	ND	ND	ND	ND
1,2-Dichloroethane	5	0.4	0.2	0.4	ND	ND	ND	ND	ND
Trichloroethylene	50	0.3	0.2	0.3	699	807	806	907	850
1,2-Dichloropropane		0.2	0.2	0.5	ND	ND	ND	ND	ND
Bromodichloromethane		0.2	0.2	0.4	ND	ND	ND	ND	ND
cis-1,3-Dichloropropylene		0.2	0.2	0.7	ND	ND	ND	ND	ND
trans-1,3-Dichloropropylene		0.2	0.2	1.1	ND	ND	ND	ND	ND
1,1,2-Trichloroethane		0.2	0.2	0.6	ND	ND	ND	ND	ND
Tetrachloroethylene		0.2	0.2	0.2	ND	ND	ND	ND	ND
Dibromochloromethane		0.3	0.2	0.4	ND	ND	ND	ND	ND
Ethylene Dibromide		0.2	0.2	0.6	ND	ND	ND	ND	ND
Chlorobenzene	80	0.2	0.2	0.6	ND	ND	ND	ND	ND
Bromoform		0.2	0.5	0.3	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane		0.2	0.2	0.4	ND	ND	ND	ND	ND
1,3-Dichlorobenzene		0.2	0.2	0.3	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	5	0.2	0.2	0.2	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	200	0.2	0.2	0.4	ND	ND	ND	ND	ND
MISA Analytical Test Group #17 (Non-Halogenated Volatiles)									
Benzene	5	0.2	0.1	0.2	ND	ND	ND	ND	ND
Toluene	24*	0.2	0.2	0.4	2	ND	ND	ND	ND
Ethylbenzene	2.4*	0.2	0.2	0.4	ND	ND	ND	ND	ND
m & p-Xylenes	300**	0.2	0.2	0.5	4	ND	ND	ND	ND
o-Xylene		0.2	0.2	0.4	2	ND	ND	ND	ND
Styrene		0.2	0.2	0.4	ND	ND	ND	ND	ND

Notes: ODWO - Ontario Drinking Water Objectives, health related parameters (July 1); DF = Dilution Factor; * - aesthetic parameters; ** - ODWO for total Xylenes

Appendix B: Ground Water Sample
Volatile Organics Analysis Results

Volatile Organic Compound	ODWO	Limit of Quantitation			Leachate Seep LS-1			GLL 9			
		Regional Lab	Barringer Lab	Zenon Lab	05-Jun-96	21-Aug-96	13-Mar-97	05-Jun-96	07-May-98	23-Jul-98	08-Oct-98
					Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab
	(ug/L)	(ug/L)	(ug/L)	(ug/L)	DF=1	DF=1		DF=10			
MISA Analytical Test Group #16 (Halogenated Volatiles)											
Chloromethane		5.1	1.0	2.3	ND		ND	ND	ND	ND	ND
Vinyl Chloride	2	6.6	1.0	2.9	ND		ND	ND	ND	ND	ND
Bromomethane		1.5	1.0	2.4	ND		ND	ND	ND	ND	ND
Trichlorofluoromethane		1.3	0.5	0.3	ND		ND	ND	ND	ND	ND
1,1-Dichloroethylene		0.4	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	50	1.2	1.0	0.3	ND	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene		0.8	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane		0.2	0.2	0.5	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene		1.0			8.3	4.7	8.4	ND	ND	ND	ND
Chloroform		0.2	0.2	0.4	0.2	ND	ND	2	ND	ND	ND
Carbon Tetrachloride	5	0.2	0.2	0.3	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	5	0.4	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	50	0.3	0.2	0.3	0.6	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane		0.2	0.2	0.5	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane		0.2	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropylene		0.2	0.2	0.7	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropylene		0.2	0.2	1.1	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane		0.2	0.2	0.6	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene		0.2	0.2	0.2	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane		0.3	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
Ethylene Dibromide		0.2	0.2	0.6	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	80	0.2	0.2	0.6	0.9	0.5	0.3	4	4.5	4.2	6
Bromoform		0.2	0.5	0.3	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane		0.2	0.2	0.4	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene		0.2	0.2	0.3	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	5	0.2	0.2	0.2	0.4	0.5	0.2	2	11.1	ND	13
1,2-Dichlorobenzene	200	0.2	0.2	0.4	ND	ND	ND	ND	1	ND	ND
MISA Analytical Test Group #17 (Non-Halogenated Volatiles)											
Benzene	5	0.2	0.1	0.2	0.5	ND	0.2	3	2.9	2.9	4
Toluene	24*	0.2	0.2	0.4	ND	ND	ND	ND	2.6	2.6	3
Ethylbenzene	2.4*	0.2	0.2	0.4	ND	ND	ND	6	24.1	21.1	31
m & p-Xylenes	300**	0.2	0.2	0.5	ND	ND	ND	5	34.5	24.8	42
o-Xylene		0.2	0.2	0.4	ND	ND	ND	4	24.8	20.7	29
Styrene		0.2	0.2	0.4	ND	ND	ND	ND	0.7	ND	ND

Notes: ODWO - Ontario Drinking Water Objectives, health related parameters (July 1994); DF = Dilution Factor; * - aesthetic parameters; ** - ODWO for total Xylenes

Appendix B: Ground Water Sample
Volatile Organics Analysis Results

Volatile Organic Compound	ODWO	Limit of Quantitation			GLL 11				
		Regional Lab	Barringer Lab	Zenon Lab	05-Jun-96	05-Jun-96	05-Jun-96	21-Aug-96	21-Aug-96
					Regional	Barringer Field Dupl.	Barringer Lab Dupl.	Regional	Zenon Lab Field Dupl.
	(ug/L)	(ug/L)	(ug/L)	(ug/L)	DF=10	DF=200	DF=200	DF=10	DF=1
MISA Analytical Test Group #16 (Halogenated Volatiles)									
Chloromethane		5.1	1.0	2.3	ND	ND	ND	ND	ND
Vinyl Chloride	2	6.6	1.0	2.9	192	ND	ND	trace	290
Bromomethane		1.5	1.0	2.4	ND	ND	ND	ND	ND
Trichlorofluoromethane		1.3	0.5	0.3	ND	ND	ND	ND	ND
1,1-Dichloroethylene		0.4	0.2	0.4	ND	ND	ND	ND	4.2
Methylene Chloride	50	1.2	1.0	0.3	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene		0.8	0.2	0.4	ND	ND	ND	ND	6.3
1,1-Dichloroethane		0.2	0.2	0.5	ND	ND	ND	ND	0.6
cis-1,2-Dichloroethylene		1.0			1270			1290	.
Chloroform		0.2	0.2	0.4	ND	ND	ND	4	ND
Carbon Tetrachloride	5	0.2	0.2	0.3	ND	ND	ND	ND	ND
1,2-Dichloroethane	5	0.4	0.2	0.4	ND	ND	ND	ND	ND
Trichloroethylene	50	0.3	0.2	0.3	699	807	806	907	850
1,2-Dichloropropane		0.2	0.2	0.5	ND	ND	ND	ND	ND
Bromodichloromethane		0.2	0.2	0.4	ND	ND	ND	ND	ND
cis-1,3-Dichloropropylene		0.2	0.2	0.7	ND	ND	ND	ND	ND
trans-1,3-Dichloropropylene		0.2	0.2	1.1	ND	ND	ND	ND	ND
1,1,2-Trichloroethane		0.2	0.2	0.6	ND	ND	ND	ND	ND
Tetrachloroethylene		0.2	0.2	0.2	ND	ND	ND	ND	ND
Dibromochloromethane		0.3	0.2	0.4	ND	ND	ND	ND	ND
Ethylene Dibromide		0.2	0.2	0.6	ND	ND	ND	ND	ND
Chlorobenzene	80	0.2	0.2	0.6	ND	ND	ND	ND	ND
Bromoform		0.2	0.5	0.3	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane		0.2	0.2	0.4	ND	ND	ND	ND	ND
1,3-Dichlorobenzene		0.2	0.2	0.3	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	5	0.2	0.2	0.2	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	200	0.2	0.2	0.4	ND	ND	ND	ND	ND
MISA Analytical Test Group #17 (Non-Halogenated Volatiles)									
Benzene	5	0.2	0.1	0.2	ND	ND	ND	ND	ND
Toluene	24*	0.2	0.2	0.4	2	ND	ND	ND	ND
Ethylbenzene	2.4*	0.2	0.2	0.4	ND	ND	ND	ND	ND
m & p-Xylenes	300**	0.2	0.2	0.5	4	ND	ND	ND	ND
o-Xylene		0.2	0.2	0.4	2	ND	ND	ND	ND
Styrene		0.2	0.2	0.4	ND	ND	ND	ND	ND

Notes: ODWO - Ontario Drinking Water Objectives, health related parameters (July 1); DF = Dilution Factor; * - aesthetic parameters; ** - ODWO for total Xylenes

Appendix B: Ground Water Sample Extractable Organics Analysis Results

Extractable Organics	ODWO			Leachate Seep LS-1			GLL 9				GLL 11			
		Regional Lab	Barringer Lab	Zenon Lab	05-Jun-96	21-Aug-96	13-Mar-97	05-Jun-96	07-May-98	23-Jul-98	08-Oct-98	05-Jun-96	05-Jun-96	21-Aug-96	21-Aug-96
					Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Barringer Lab Field Dupl.	Regional Lab	Zenon Lab Field Dupl
	(ug/L)	(ug/L)	(ug/L)	(ug/L)	DF=1	DF=1		DF=5				DF=1	DF=1	DF=1	DF=1
MISA Analytical Test Group #19 (Base/Neutral Extractables)															
Camphene		0.9	1.0	1.0	ND	ND	ND	ND	3.1	2.4	ND	ND	ND	ND	ND
Bis(2-chloroethyl)ether		1.0	0.5	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroisopropyl)ether		1.8	0.5	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodi-n-propylamine		2.9	0.5	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroethoxy)methane		1.2	0.5	1.3	ND	ND	ND	22.7	ND	ND	ND	3.5	1.3	ND	ND
Naphthalene		0.8	0.2	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indole		2.5	1.0	0.6	ND	ND	ND	ND	ND	ND	ND	4.2	2.1	ND	ND
2-Methylnaphthalene		0.9	0.2	1.5	ND	ND	ND	ND	ND	ND	ND	2.8	1.5	ND	ND
1-Methylnaphthalene		0.9	0.2	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Biphenyl		1.0	0.5	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene		1.2	0.5	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Chloronaphthalene		1.7	0.5	0.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenyl ether		0.8	0.5	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene		2.7	0.5	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene		1.4	0.2	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene		2.0	0.2	0.7	ND	ND	ND	ND	ND	3.1	ND	2.2	1.1	ND	ND
2,4-Dinitrotoluene		1.6	0.5	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether		1.7	0.5	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene		1.8	0.2	0.3	ND	ND	ND	ND	ND	2.9	ND	2	1.1	ND	ND
Diphenylamine		1.8		1.9	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND
4-Bromophenyl phenyl ether		1.7	0.5	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene		1.4	0.2	0.3	ND	ND	ND	ND	ND	2.2	ND	2.8	2.1	ND	ND
Anthracene		1.0	0.2	0.2	ND	ND	ND	ND	ND	1.1	ND	ND	0.4	ND	ND
Di-n-butylphthalate		1.6	2.0	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.4
5-Nitroacenaphthene		1.5	1.0	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene		2.1	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	0.3	ND	0.3
Pyrene		2.3	0.2	0.3	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	0.3
Benzyl butyl phthalate		1.4	0.5	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl) phthalate		2.3	2.0	1.4	ND	2.9	3.1	ND	4.3	7.2	16.5	ND	ND	4.7	6.7
Benzo[a]anthracene		2.1	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene		2.5	0.2	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate		2.9	2.0	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene		2.6	0.2	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene		2.3	0.2	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	0.01	2.7	0.2	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perylene		2.4	0.2	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene		2.9	0.2	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzo[a,h]anthracene		3.4	0.2	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene		2.6	0.2	0.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MISA Analytical Test Group #20 (Acid Extractables)															
2,3,4,5-Tetrachlorophenol			0.5	0.4									ND		ND
2,3,4,6-Tetrachlorophenol	100		0.5	0.7									ND		ND
2,3,5,6-Tetrachlorophenol			0.5	0.7									ND		ND
2,3,4-Trichlorophenol			0.5	0.5									ND		ND
2,3,5-Trichlorophenol			0.5	0.4									ND		ND
2,4,5-Trichlorophenol	280		0.5	0.6									ND		ND
2,4,6-Trichlorophenol	5		0.5	1.2									ND		ND
2,4-Dimethylphenol			0.5	1.7									0.5		ND
2,4-Dinitrophenol			2.0	4.8									ND		ND
2,4-Dichlorophenol	900		0.5	1.2									ND		ND
2,6-Dichlorophenol			0.5	1.1									ND		ND
4,6-Dinitro-o-cresol			2.0	1.5									ND		ND
2-Chlorophenol			0.5	2.7									ND		ND
4-Chloro-3-methylphenol			0.5	1.4									ND		ND
4-Nitrophenol			2.0	1.4									ND		ND
m-Cresol			0.5	3.0									ND		ND
o-Cresol			0.5	1.7									ND		ND
p-Cresol			0.5	3.5									ND		ND
Pentachlorophenol	60		1.0	1.1									ND		ND
Phenol			0.5	1.1									ND		ND

Notes: ODWO - Ontario Drinking Water Objectives, health related parameters (July 1994); DF - Dilution Factor

Appendix C

Surface Water Flow and Water Quality Data

1998 FLOW DATA FOR REDHILL CREEK AT QUEENSTON ROAD, HAMILTON (m^3/s)

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.297	0.312	1.92	0.6	0.235	0.161	0.186	0.178	0.184	0.532	0.0257	0.453
2	0.237	0.412	0.821	0.947	0.23	0.205	0.135	0.18	0.183	0.158	0.0226	0.0804
3	0.42	0.417	0.583	0.543	0.357	0.136	0.12	0.181	0.179	0.155	0.0217	0.0613
4	2.22	0.36	0.5	0.434	0.227	0.111	1.84	0.182	0.177	0.154	0.0197	0.0523
5	1.64	0.304	0.399	0.386	0.21	0.109	0.274	0.183	0.182	0.152	0.0182	0.197
6	4.96	0.344	0.351	0.347	0.2	0.108	0.167	0.35	0.186	0.151	0.019	0.116
7	5.89	0.263	0.333	0.32	0.193	0.106	1.34	0.18	0.441	0.988	0.0158	0.202
8	13.5	0.255	3.01	0.358	0.189	0.105	1.65	0.146	0.781	0.786	0.0384	0.0671
9	5.8	0.303	6.3	0.292	0.191	0.104	0.722	0.154	0.247	0.166	0.0257	0.0488
10	2.03	0.316	1.85	0.263	0.919	0.104	0.368	0.203	0.218	0.12	0.883	0.0427
11	0.967	0.436	0.662	0.249	3.56	0.106	0.245	0.604	0.213	0.085	0.353	0.0385
12	0.514	1.36	0.515	0.257	0.826	0.864	0.222	0.19	0.209	0.065	0.0749	0.038
13	1.04	0.78	0.392	0.304	0.332	0.601	0.204	0.184	0.207	0.055	0.0458	0.0398
14	0.466	0.446	0.453	1.24	0.269	0.19	0.185	0.184	0.204	0.085	0.0404	0.0403
15	0.411	0.373	0.387	0.474	0.235	0.14	0.18	0.886	0.219	0.045	0.0439	0.037
16	0.537	0.295	0.331	2.9	0.216	0.857	1.64	0.225	0.362	0.05	0.219	0.0387
17	0.378	8.09	0.329	1.6	0.207	0.24	0.699	0.203	0.199	0.07	0.307	0.0742
18	0.312	6.98	2.03	0.537	0.199	0.15	0.255	0.507	0.193	0.103	0.0908	0.044
19	0.29	5.14	9.39	1.79	0.186	0.129	0.211	0.197	0.192	0.045	0.0606	0.355
20	0.27	2.95	3.02	4.06	0.179	0.123	0.19	0.192	0.161	0.04	0.0443	0.095
21	0.257	1.91	1.34	1.03	0.171	0.119	0.191	0.208	0.153	0.05	0.0367	0.762
22	0.24	1.12	0.835	0.618	0.161	0.119	0.177	0.957	0.153	0.059	0.0349	0.906
23	0.35	0.76	0.842	0.43	0.157	0.164	0.199	0.201	0.155	0.05	0.0328	0.172
24	0.313	0.626	1.26	0.373	0.152	0.122	0.181	0.191	0.149	0.042	0.029	0.1
25	0.272	0.498	1.95	0.335	0.157	0.165	0.183	0.191	0.146	0.04	0.0315	0.0802
26	0.241	0.427	17.6	0.318	0.17	0.171	0.181	0.191	0.142	0.042	0.657	0.0918
27	0.242	0.429	6.59	0.292	0.142	0.11	0.181	0.191	0.312	0.04	0.088	0.0809
28	0.239	0.387	3.91	0.284	0.14	0.112	0.181	0.191	0.143	0.038	0.0601	0.0974
29	0.321		2.17	0.255	0.142	0.108	0.228	0.197	0.144	0.04	0.0576	0.101
30	0.419		1.07	0.246	0.142	1.6	0.18	0.191	0.28	0.0272	0.0721	0.115
31	0.296		0.643		0.312		0.177	0.187		0.0275		0.0386
Minimum	0.237	0.255	0.329	0.246	0.14	0.104	0.12	0.146	0.142	0.0272	0.0158	0.037
Maximum	13.5	8.09	17.6	4.06	3.56	1.6	1.84	0.957	0.781	0.988	0.883	0.906
Mean	1.46	1.30	2.32	0.74	0.36	0.25	0.42	0.26	0.22	0.14	0.12	0.15
Total Flow (million m^3)	3.92	3.14	6.20	1.91	0.95	0.64	1.11	0.71	0.58	0.39	0.30	0.40

Notes: Flow data from Environment Canada, Water Survey Division, Gauge Station No. 02HA014

Appendix C: Surface Water Sample
Extractable Organics Analysis Results

Extractable Organics	PWQO	Detection Limit		SSE			DP-A	DP-B	Travel Blank			
		Regional Lab	Barringer Lab	31-May-96	21-Aug-96	12-Mar-97	21-Nov-96	21-Nov-96	05-Jun-96	21-Nov-96	12-Mar-97	13-Mar-97
				Barringer Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab	Regional Lab
	(ug/L)	(ug/L)	(ug/L)	DF=1	DF=1		DF=1	DF=1	DF=1	DF=1		
MISA Analytical Test Group #19 (Base/Neutral Extractables)												
Camphene	2	0.9	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroethyl)ether	200	1.0	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroisopropyl)ether		1.8	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodi-n-propylamine		2.9	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroethoxy)methane		1.2	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	7	0.8	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indole		2.5	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	2*	0.9	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Methylnaphthalene	2*	0.9	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Biphenyl	0.2	1.0	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	0.2	1.2	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Chloronaphthalene	0.1	1.7	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenyl ether	0.03	0.8	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	3*	2.7	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene		1.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene		2.0	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	4*	1.6	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	0.05	1.7	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	0.2	1.8	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenylamine	3	1.8		ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Bromophenyl phenyl ether	0.05	1.7	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.03	1.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	0.0008	1.0	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	4	1.6	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
5-Nitroacenaphthene		1.5	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.0008	2.1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene		2.3	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl butyl phthalate	0.2	1.4	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl) phthalate		2.3	2.0	ND	ND	3.9	4.1	8.9	ND	3.4	2.8	5.4
Benzo[a]anthracene	0.0004	2.1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.0001	2.5	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate		2.9	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene		2.6	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	0.0002	2.3	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene		2.7	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perylene	7E-05	2.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene		2.9	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzo[a,h]anthracene	0.002	3.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	2E-05	2.6	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes: PWQO - Provincial Water Quality Objectives (July 1994); * - Interim PWQO currently under development; DF - Dilution Factor

Appendix C: Surface Water Sample Extractable Organics Analysis Results

Extractable Organics	PWQO	Detection Limit		SW1			SW2			SW3		
		Regional Lab	Barringer Lab	31-May-96	21-Aug-96	12-Mar-97	31-May-96	21-Aug-96	13-Mar-97	31-May-96	21-Aug-96	12-Mar-97
				Barringer Lab DF=1	Regional Lab DF=1	Regional Lab	Barringer Lab DF=1	Regional Lab DF=1	Regional Lab	Barringer Lab DF=1	Regional Lab DF=1	Regional Lab
	(ug/L)	(ug/L)	(ug/L)									
MISA Analytical Test Group #19 (Base/Neutral Extractables)												
Camphene	2	0.9	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroethyl)ether	200	1.0	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroisopropyl)ether		1.8	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-nitrosodi-n-propylamine		2.9	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroethoxy)methane		1.2	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	7	0.8	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indole		2.5	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	2*	0.9	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Methylnaphthalene	2*	0.9	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Biphenyl	0.2	1.0	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	0.2	1.2	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Chloronaphthalene	0.1	1.7	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenyl ether	0.03	0.8	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	3*	2.7	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene		1.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene		2.0	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	4*	1.6	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	0.05	1.7	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	0.2	1.8	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenylamine	3	1.8		ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Bromophenyl phenyl ether	0.05	1.7	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.03	1.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	0.0008	1.0	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	4	1.6	2.0	ND	ND	1.6	ND	ND	ND	ND	ND	ND
5-Nitroacenaphthene		1.5	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.0008	2.1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene		2.3	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl butyl phthalate	0.2	1.4	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl) phthalate		2.3	2.0	ND	ND	2.6	ND	ND	4	ND	5.8	2.9
Benzo[a]anthracene	0.0004	2.1	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.0001	2.5	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate		2.9	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene		2.6	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	0.0002	2.3	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene		2.7	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Perylene	7E-05	2.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene		2.9	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzo[a,h]anthracene	0.002	3.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	2E-05	2.6	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes: PWQO - Provincial Water Quality Objectives (July 1994); * - Interim PWQO currently under development; DF - Dilution Factor

Appendic C: Surface Water Volatile Organics Analysis Results
Closed Brampton Street Landfill Site

Volatile Organic Compound	PWQO (ug/L)	Detection Limit		SW-1			SW-2		SW-3		SW-4			
		Regional Lab (ug/L)	Barringer Lab (ug/L)	31-May-96 Barringer DF=1	31-May-96 Barringer DF=1 Lab Dup	21-Aug-96 Regional DF=1	31-May-96 Barringer DF=1	21-Aug-96 Regional DF=1	31-May-96 Barringer DF=1	21-Aug-96 Regional DF=1	31-May-96 Barringer DF=1	21-Aug-96 Regional DF=1	21-Nov-96 Regional DF=1	12-Mar-97 Regional
MISA Analytical Test Group #16 (Halogenated Volatiles)														
Chloromethane	700	5.1	1.0	ND	ND		ND		ND		ND		ND	ND
Vinyl Chloride	400	6.6	0.5	ND	ND		ND		ND		ND		ND	ND
Bromomethane	0.9	1.5	1.0	ND	ND		ND		ND		ND		ND	ND
Trichlorofluoromethane		1.3	0.5	ND	ND		ND		ND		ND		ND	ND
1,1-Dichloroethylene	40	0.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	100	1.2	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene	200	0.8	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	200	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	200	1.0	0.2	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND
Chloroform		0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride		0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	100	0.4	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	20	0.3	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	0.7	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	200	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropylene		0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropylene	7	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	800	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	50	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	40	0.3	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylene Dibromide	5	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	15	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	60	0.2	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	70	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	2.5	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	4	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	2.5	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MISA Analytical Test Group #17 (Non-Halogenated Volatiles)														
Benzene	100*	0.2	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	0.8	0.2	0.2	ND	ND	ND	ND	ND	0.4	ND	1.2	ND	ND	ND
Ethylbenzene	8	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND
m&p-Xylenes	32*	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	0.2
o-Xylene	40*	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Styrene	4*	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes: PWQO - Provincial Water Quality Objectives (Revised 1994); DF= Dilution Factor; * - Interim PWQO currently under development

Appendix C: Surface Water Quality Data

Closed Brampton Street Landfill Site

Analytical Parameter			PWQO	Storm Sewer Outfall SSN							
				30-May-96	12-Jul-96	21-Aug-96	23-Oct-96	21-Nov-96	12-Mar-97	16-Apr-97	07-Jul-97
General Parameters											
pH (Field)			6.5-8.5	8.5	8	7.92	8				
Temperature (Field)		°C		14.7	16.4	19.6	10.7				
Disolved Oxygen (Field)	DO	mg/L		13	4	2.6	3				
Conductivity (Field)		us/cm		1390	1352	1421	1222				
pH (Lab)			6.5-8.5	8.56							
Conductivity (lab)		umhos.cm									
Total Suspended Solid	TSS	mg/L		6.6	5	10.8	9.3	5.8	<1.5	3.6	9.6
Total Dissolved Solid	TDS	mg/L			838	990					
Alkalinity		mg/L		290.5	344	153	184	167	274	310	323
Sodium	Na	mg/L		89.3	89.1	91.6	58.1	75.1	59.3	75	74 6
Calcium	Ca	mg/L		131	122	115	122	121	105	115	115
Magnesium	Mg	mg/L		66.8	59.1	65	53.4	66.3	46	54.8	58 9
Potassium	K	mg/L		11	12.2	12.4	16 8	10.8	9.3	10	11 8
Chloride	CL	mg/L		117	102	130	83	94	58	79	93
Sulphate	SO4	mg/L		346	286	320	416	37	208	248	298
Nitrate	NO3	mg/L		0.8	0.38	0.058	0.486	0.691	0.55	0.696	0.133
Nitrite	NO2	mg/L		<0.2	0.044	0.027	0.06	0.042	0.042	0.053	0.028
Ammonia	NH3-N	mg/L			3.4	2.5	0.7	1.6	0.8	1.3	2.4
Total Kjeldahl Nitrogen	TKN	mg/L		2.4	4.4	3.2	1.8	2.2	1.2	1.9	2.6
Unionized NH3	Free NH3	mg/L	0.02		0.1001	0.0775	0.0135				
Ortho Phosphorus	PO4	mg/L		<1		1.6					
Total Phosphorus	P	mg/L	0.01	0.173	2.25	1.6	0.586	1.23	1.51	1.93	1.76
Phenols		mg/L	0 001	<0.0005	0.002	<0.002	<0.002	<0.002	<0.002	<0.003	<0.003
Chemical Oxygen Demand	COD	mg/L		29	40	59	40	37	29	35	54
Biological Oxygen Demand	BOD	mg/L		20.7	<3	22	<4	<6	<4	<4	22
Dissolved Organic Carbon	DOC	mg/L		8.4	26	9.5	9.2	7.7	21	8.3	5.2
Trace Metals											
Aluminum	Al	mg/L	0.075	0.122	0.059	0.02	0.011	0.019	0.022	<0.01	<0.05
Beryllium	Be	mg/L	1.1	<0.001	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	0.0001
Cadmium	Cd	mg/L	0.0002	0.0002	0.0007	0.0002	0.0001	0.0001	0.0002	<0.0001	0.0006
Chromium	Cr	mg/L	0.1	<0.005	<0.002	<0.005	0.008	<0.002	0.003	<0.002	0.0006
Cobalt *	Co	mg/L	0.0006 *	0.0004	<0.005	0.012	<0.005	<0.005	<0.005	<0.005	<0.001
Copper	Cu	mg/L	0.005	0.0077	0.03	0.005	0.02	<0.01	0.046	0.034	0.0006
Nickle	Ni	mg/L	0.025	0.008	0.016	0.016	0.012	0.006	0.022	0.009	0.016
Lead	Pb	mg/L	0.025	0.001	0.13	0.026	<0.005	<0.005	0.007	<0.005	<0 005
Zinc	Zn	mg/L	0.03	0.041	0.08	0.09	0.06	0.06	0.1	0.04	0.0428
Silver	Ag	mg/L	0.0001	<0.00005	<0.001	<0.001	<0.001	<0.001	<0.03	<0.001	<0.004
Molybdenum	Mo	mg/L	0.01	0.027	0.024	0.016	0.014	0.019	0.018	0.024	<0.004
Vanadium	V	mg/L	0.007 *	0.0063	<0.005	0.006	0.005	<0.005	0.01	0.007	0.0006
Iron	Fe	mg/L	0.3	0.27	0.22	0.24	0.26	0.18	0.24	0.11	0.325
Manganese	Mn	mg/L		0.16	0.3	0.24	0.18	0.15	0.1	0.15	0.232
Strontium	Sr	mg/L		0.381	0.41	0.39	0.54	0.42	0.32	0.39	0.4
Barium	Ba	mg/L		0.03	0.05	0.22	0.05	0.05	0.04	<0.03	0.039
Boron	B	mg/L	0.2	9.33	8.1	8.1	3.8	7.1	0.95	6.9	6.5

PWQO - Provincial Water Quality Objectives (July 1994): PWQO for alumimum if for filtered sample

* - Interim PWQO currently under development

Appendix C: Surface Water Quality Data
Closed Brampton Street Landfill Site

Analytical Parameter			PWQO	Storm Sewer Outfall SSE						
				30-May-96	12-Jul-96	21-Aug-96	23-Oct-96	21-Nov-96	12-Mar-97	16-Apr-97
General Parameters										
pH (Field)			6.5-8.5	7.9	7.9	7.13	7.4			
Temperature (Field)		°C		10.8	16	18.7	14.4			
Disolved Oxygen (Field)	DO	mg/L		8	9	4.6	3			
Conductivity (Field)		us/cm		1934	2610	1399	1128			
pH (Lab)			6.5-8.5	7.86						
Conductivity (lab)		umhos.cm								
Total Suspended Solid	TSS	mg/L		3.3	2	4.4	61	7.6	17.6	10.4
Total Dissolved Solid	TDS	mg/L			1630	876				
Alkalinity		mg/L		180.1	185	91.8	197	168	202	200
Sodium	Na	mg/L		18.5	194	101	114	114	266	229
Calcium	Ca	mg/L		161	251	123	145	139	178	194
Magnesium	Mg	mg/L		52	44.6	31	35.1	32.1	47	52.5
Potassium	K	mg/L		36	74	21.4	25 2	33 6	31.1	35.9
Chloride	CL	mg/L		313	606	213	206	274	513	465
Sulphate	SO4	mg/L		418	334	251	297	24	372	422
Nitrate	NO3	mg/L		1.3	1 16	<0 023	0 235	0.092	0.782	0 983
Nitrite	NO2	mg/L		<0.2	0.223	0.012	0.076	0.028	0 067	0.099
Ammonia	NH3-N	mg/L			0.6	0.1	1.3	1.5	0.09	0.4
Total Kjeldahl Nitrogen	TKN	mg/L		1.1	1 4	<0.6	1 6	1.6	1	1.3
Unionized NH3	Free NH3	mg/L	0.02		0.0137	0.0005	0.0085			
Ortho Phosphorus	PO4	mg/L		<1		0.046				<0.024
Total Phosphorus	P	mg/L	0.01	0.067	0.05	0.105	0.606	0.13	0.047	<0 024
Phenols		mg/L	0.001	<0.0005	0.006	<0.002	0 005	<0 002	0.004	<0 003
Chemical Oxygen Demand	COD	mg/L		10	39	83	674	33	57	34
Biological Oxygen Demand	BOD	mg/L		7.7	<3	39	>226	28	21	7
Dissolved Organic Carbon	DOC	mg/L		4 8	4.6	23	210	8.6	7.9	7.2
Trace Metals										
Aluminum	Al	mg/L	0.075	0.154	0.061	0.218	0.658	<0.01	0.082	0 076
Beryllium	Be	mg/L	1.1	<0.001	<0 01	<0.001	<0.01	<0.01	<0 01	<0 01
Cadmium	Cd	mg/L	0.0002	0.0003	0.0015	0.0005	0 001	0.0002	0.0003	0 0007
Chromium	Cr	mg/L	0.1	<0.005	<0.002	<0.004	0 009	<0 002	0.002	<0 002
Cobalt *	Co	mg/L	0.0006 *	0.0002	<0.005	0.009	<0.005	<0 005	<0.005	<0 005
Copper	Cu	mg/L	0.005	0.014	0 03	0.009	0.08	0.02	0.067	0 038
Nickle	Ni	mg/L	0.025	0.005	0.045	0.011	0 006	0.008	0 013	0 006
Lead	Pb	mg/L	0.025	0.0067	0 21	0.018	0.11	<0.005	0.008	<0.005
Zinc	Zn	mg/L	0 03	0.06	0.19	0.15	0.19	0 05	0.11	0 08
Silver	Ag	mg/L	0.0001	<0.00005	<0.001	<0 001	<0 001	<0.001	<0.03	<0.001
Molybdenum	Mo	mg/L	0.01	0.016	0 021	<0 005	0 017	<0 01	0.016	0 024
Vanadium	V	mg/L	0.007 *	0.0043	0 012	0.005	0.011	<0 005	0.017	0 011
Iron	Fe	mg/L	0.3	0.09	0 21	0 64	7.46	0.41	0 59	0.15
Manganese	Mn	mg/L		0.059	0.22	0 32	0.78	0 26	0.36	0.19
Strontium	Sr	mg/L		1.18	1.53	0.92	1.44	1 07	1 28	1 34
Barium	Ba	mg/L		0.043	0.1	0.15	0.08	0.09	0.1	0.08
Boron	B	mg/L	0.2	0 561	0.47	0.33	0 49	0.34	5.9	0 42

PWQO - Provincial Water Quality Objectives (July 1994): PWQO for alumimum if for filtered sample
* - Interim PWQO currently under development

Appendix C: Surface Water Quality Data
Closed Brampton Street Landfill Site

Analytical Parameter			PWQO	Storm Sewer Outfall SSW								
				30-May-96	12-Jul-96	21-Aug-96	23-Oct-96	21-Nov-96	12-Mar-97	16-Apr-97	07-Jul-97 Filtered	07-Jul-97
General Parameters												
pH (Field)			6.5-8.5	7.4	7 6	7.75	7.4					
Temperature (Field)		°C		13.8	18	20 6	11.7					
Disolved Oxygen (Field)	DO	mg/L		4	7	3.5	3					
Conductivity (Field)		us/cm		658	8800	10640	8170					
pH (Lab)			6.5-8.5	7.73								
Conductivity (lab)		umhos.cm										2170
Total Suspended Solid	TSS	mg/L		19.5	40.7	281	95	390	40.4	74.8		
Total Dissolved Solid	TDS	mg/L			4520	5970						
Alkalinity	'	mg/L		714.3	797	400	715	738	694	662	49	791
Sodium	Na	mg/L		1070	1500	1870	1550	1790	1100	1050	1140	1110
Calcium	Ca	mg/L		190	213	241	227	224	220	172	123	183
Magnesium	Mg	mg/L		109	114	131	109	118	107	113	142	154
Potassium	K	mg/L		32	54.2	62.1	46.4	53	38 3	43	79.1	81 4
Chloride	CL	mg/L		1810	2860	3410	2800	3300	2060	1830	1890	
Sulphate	SO4	mg/L		127	83	46	112	21	205	191	158	
Nitrate	NO3	mg/L		0.8	0.246	0.276	1.35	1.98	0.403	0.248	<0.023	
Nitrite	NO2	mg/L		<2.0	0.198	1.51	0.89	1.96	0.024	0.054	0.011	0.01
Ammonia	NH3-N	mg/L			45.6	48.4	31.6	39.3	32.5	35.2	88.8	
Total Kjeldahl Nitrogen	TKN	mg/L		29	48.8	52.2	35.4	42.2	34.6	37	91	95
Unionized NH3	Free NH3	mg/L	0.02		0.6122	1.1006	0.1674					
Ortho Phosphorus	PO4	mg/L		<1		0.092				0.124		
Total Phosphorus	P	mg/L	0.01	0.06	0.072	0.302	0.086	0.253	0.068	0.124	0 071	1.33
Phenols		mg/L	0.001	<0.0005	0.002	<0.002	<0.002	<0.002	<0.002	<0.003		<0.003
Chemical Oxygen Demand	COD	mg/L		105	188	265	118	213	80	100	385	360
Biological Oxygen Demand	BOD	mg/L		2.2	<5	33	6	19	6	4		105
Dissolved Organic Carbon	DOC	mg/L		35	9.4	27	23	13	9.6	11		
Trace Metals												
Aluminum	Al	mg/L	0.075	0.054	0.026	0.194	0.036	0.074	0.018	<0.01	0.36	
Beryllium	Be	mg/L	1.1	<0.001	<0.01	0 002	<0.01	<0.01	<0 01	<0.01	0.0004	0.0015
Cadmium	Cd	mg/L	0.0002	0.0001	0.0004	0.0003	0.0002	0 0004	0.0002	0.0002	0.0006	0.0012
Chromium	Cr	mg/L	0.1	0.006	0.003	0.017	0.012	0.006	0.004	0.004	0.0006	0.0566
Cobalt *	Co	mg/L	0.0006 *	0.0023	<0.005	0.053	0.005	<0.005	<0.005	<0.005	<0.001	0.008
Copper	Cu	mg/L	0.005	0.0238	0.04	0.031	0.05	0.04	0.17	0.128	0.0006	0.0581
Nickle	Ni	mg/L	0.025	0.007	0.017	0.071	0.013	0.008	0.026	0.013	0.02	0.058
Lead	Pb	mg/L	0.025	<0.0005	0.3	0.096	0.16	0.21	0.008	0.015	<0.005	0.091
Zinc	Zn	mg/L	0.03	0.015	0.09	0.19	0.1	0.08	0.1	0.04	0.0049	0.35
Silver	Ag	mg/L	0.0001	<0.00005	<0.001	<0.001	<0.001	<0.001	<0.03	<0.001	<0.004	<0.008
Molybdenum	Mo	mg/L	0.01	0.01	0.014	0.009	0.013	0.012	0.01	0.012	<0.004	<0.008
Vanadium	V	mg/L	0.007 *	0.0016	0.005	0.022	0.023	0 02	0.016	0.01	0.0033	0.0362
Iron	Fe	mg/L	0.3	0.92	2.02	10.5	7.08	4.09	1.8	1.86	0.442	34.2
Manganese	Mn	mg/L		0.889	1.38	1.79	1.16	1.08	1.04	0.96	0.657	1.72
Strontium	Sr	mg/L		1.77	2.22	2.76	2.49	2.62	1.83	1.61	1.42	1.56
Barium	Ba	mg/L		0.612	0.84	1.27	1.04	0.95	0.7	0.55	0.5	0.693
Boron	B	mg/L	0 2	1.06	1.4	1.6	1.2	1.4	0.38	1.2	2	2

PWQO - Provincial Water Quality Objectives (July 1994): PWQO for alumimum if for filtered sample
* - Interim PWQO currently under development

Appendix C: Surface Water Quality Data
Closed Brampton Street Landfill Site

Analytical Parameter			PWQO	Surface Water Monitoring Station SW-4								
				30-May-96	12-Jul-96	21-Aug-96	23-Oct-96	23-Oct-96 Field Dupl.	21-Nov-96	12-Mar-97	16-Apr-97	07-Jul-97
General Parameters												
pH (Field)			6.5-8.5	8.1	8.4	7.00	8.2	8.2				
Temperature (Field)		°C		20.3	19.4	24.4	10.4	10.4				
Disolved Oxygen (Field)	DO	mg/L		9	6	5.9	10	10				
Conductivity (Field)		us/cm		1386	1302	1411	1107	1107				
pH (Lab)			6.5-8.5	8.06				8.12				
Conductivity (lab)		umhos.cm										
Total Suspended Solid	TSS	mg/L		48.3	35.5	30	17.3	5	8	24.6	15	70.6
Total Dissolved Solid	TDS	mg/L			770	850						
Alkalinity		mg/L		170.2	189	79.4	224	220	216	172	181	130
Sodium	Na	mg/L		140	127	127	83.1	87	118	154	174	131
Calcium	Ca	mg/L		118	102	105	111	110	118	100	110	102
Magnesium	Mg	mg/L		40.9	30.7	34.1	29.4	28	36.5	25.5	36.5	32.3
Potassium	K	mg/L		6	6.4	6.9	5.8	6	5.3	5	5.3	6.1
Chloride	CL	mg/L		238	221	238	139	130	222	267	309	246
Sulphate	SO4	mg/L		221	176	214	200	200	26	132	201	221
Nitrate	NO3	mg/L		1.4	1.34	0.9	2.57	2.5	1.22	2.23	1.12	1.23
Nitrite	NO2	mg/L		<0.2	0.091	0.078	0.039	<0.05	0.03	0.027	0.023	0.058
Ammonia	NH3-N	mg/L			0.3	0.3	0.2	0.21	0.2	0.3	0.2	0.3
Total Kjeldahl Nitrogen	TKN	mg/L		1.18	1.2	0.7	0.9	0 85	1.1	1	1	0.7
Unionized NH3	Free NH3	mg/L	0.02		0.0261	0.0016	0.0059	0 0062				
Ortho Phosphorus	PO4	mg/L		<1		<0.024					<0.024	
Total Phosphorus	P	mg/L	0.01	0.142	0.092	0.103	0.123	0.14	0.052	0.094	<0.024	0.094
Phenols		mg/L	0.001	<0.0005	0.007	<0.002	<0.002	<0.001	0.002	<0.002	<0.003	<0.003
Chemical Oxygen Demand	COD	mg/L		21	25	40	17	16	23	14	21	43
Biological Oxygen Demand	BOD	mg/L		2.5	<5	8	<4	<5	15	<4	<4	12
Dissolved Organic Carbon	DOC	mg/L		3.7	5.1	4.9	5.1	4.7	4	7.2	3.6	1.9
Trace Metals												
Aluminum	Al	mg/L	0.075	0.523	0.012	0.013	0.016	0.33	<0.01	0.026	<0 01	<0.05
Beryllium	Be	mg/L	1.1	<0.001	<0.01	<0.001	<0.01	<0.001	<0.01	<0.01	<0.01	0.0001
Cadmium	Cd	mg/L	0.0002	0.0001	0.0006	0.0003	0.0001	0.003	0.0002	0.0001	0.0002	0.0006
Chromium	Cr	mg/L	0.1	<0.005	0.004	<0.004	0.002	<0.004	<0.002	0.002	<0.002	0.001
Cobalt *	Co	mg/L	0.0006 *	0.0005	<0.005	0.01	<0.005	<0.01	<0.005	<0.005	<0.005	<0.001
Copper	Cu	mg/L	0.005	0.0082	0.05	0.012	0.03	<0.006	0 02	0.038	0.048	0 0024
Nickle	Ni	mg/L	0.025	0.004	0.028	0.016	0.006	<0.01	0.029	0.025	<0.005	0.01
Lead	Pb	mg/L	0.025	0.0031	0.16	0.029	<0.005	0.025	<0.005	<0.005	<0.005	0.006
Zinc	Zn	mg/L	0.03	0.025	0.1	0.1	0.1	0.037	0.08	0.14	0.06	0.0557
Silver	Ag	mg/L	0.0001	<0.00005	0.002	<0.001	<0.01	<0.01	<0.01	<0.03	<0.001	<0.004
Molybdenum	Mo	mg/L	0.01	0.005	<0.01	<0 005	<0.01	<0.01	<0.01	<0 01	0 017	<0.004
Vanadium	V	mg/L	0 007 *	<0.0005	0 014	<0.005	<0.005	<0.005	<0 005	0.005	<0.005	0.0018
Iron	Fe	mg/L	0.3	0.93	1.76	1.25	0.64	0.42	0.29	1.37	0.42	2 22
Manganese	Mn	mg/L		0.198	0.23	0.18	0.06	0.053	0.08	0.07	0.1	0.182
Strontium	Sr	mg/L		1.67	1.55	1.97	1.51	1.6	1.96	1.21	1.7	1.76
Barium	Ba	mg/L		0.067	0.07	0.2	0.04	0.051	0.06	0.09	0.05	0.07
Boron	B	mg/L	0.2	0.243	0.17	0.19	0.14	0 14	0.17	0.077	0.14	0 16

PWQO - Provincial Water Quality Objectives (July 1994): PWQO for alumimum if for filtered sample

* - Interim PWQO currently under development

Appendix C: Surface Water Quality Data
Closed Brampton Street Landfill Site

Analytical Parameter			PWQO	Surface Water Monitoring Station SW-3									
				30-May-96	12-Jul-96	12-Jul-96 Field Dupl.	21-Aug-96	23-Oct-96	23-Oct-96 Field Dupl.	21-Nov-96	12-Mar-97	16-Apr-97	07-Jul-97
General Parameters													
pH (Field)			6.5-8.5	7.9	7.8	7.8	7.52	8.2	8.2				
Temperature (Field)		°C		16.5	21.1	21.1	22.5	10.2	10.2				
Disolved Oxygen (Field)	DO	mg/L		11	9	9	6.7	10	10				
Conductivity (Field)		us/cm		1472	1400	1400	1435	1107	1107				
pH (Lab)			6.5-8.5	7.99		8.17							
Conductivity (lab)		umhos.cm											
Total Suspended Solid	TSS	mg/L		8.3	34.5	40	17.6	8.6	10	2	16.4	16.6	29 2
Total Dissolved Solid	TDS	mg/L			830		858						
Alkalinity		mg/L		173.5	202	190	81.8	224	222	212	180	169	142
Sodium	Na	mg/L		141	133	130	131	83.6	83.6	117	161	172	118
Calcium	Ca	mg/L		111	120	120	112	112	114	121	106	108	95.1
Magnesium	Mg	mg/L		38 3	35.2	33	34.7	29 5	29.5	37.9	27.1	36.7	29
Potassium	K	mg/L		6	33.3	6.6	7.4	5.8	5.9	5.8	5	5.4	5 6
Chloride	CL	mg/L		235	235	230	243	136	139	218	271	308	221
Sulphate	SO4	mg/L		219	195	220	243	207	213	26	135	203	205
Nitrate	NO3	mg/L		1.5	1.64	2.1	0.988	2.8	2.58	1.39	2.3	1.2	1.19
Nitrite	NO2	mg/L		<0.2	0.066	0.14	0.068	0.044	0.039	0.032	0.032	0.023	0.052
Ammonia	NH3-N	mg/L			0.3	0.55	0.4	0.2	0.2	0 2	0.3	0.2	0.1
Total Kjeldahl Nitrogen	TKN	mg/L		0.86	1.4	1.4	0.8	1.3	0.9	1.2	1.1	1.4	<0 6
Unionized NH3	Free NH3	mg/L	0.02		0.0079	0.0145	0.0062	0.0058	0.0058				
Ortho Phosphorus	PO4	mg/L		<1			<0.024					<0.024	
Total Phosphorus	P	mg/L	0.01	0.044	0.065	0.11	0.071	0.138	0.134	0.044	0.079	<0.024	0.051
Phenols		mg/L	0.001	<0.0005	0.008	<0.001	<0.002	<0.002	<0 002	<0.002	<0.002	<0.003	<0.003
Chemical Oxygen Demand	COD	mg/L		16	20	54	35	28	16	28	14	18	40
Biological Oxygen Demand	BOD	mg/L		1.4	<3	<5	10	<4	<4	15	<4	<4	11
Dissolved Organic Carbon	DOC	mg/L		2.7	3.9	3.6	5.3	4.3	4.3	4	6.8	3.6	3
Trace Metals													
Aluminum	Al	mg/L	0.075	0.138	0.216	0.67	<0.01	0.022	0.02	<0.01	0.052	<0.01	0.08
Beryllium	Be	mg/L	1.1	<0.001	<0.01	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	0.0001
Cadmium	Cd	mg/L	0.0002	<0.0001	0.0005	<0.002	0.0002	0.0002	0.0002	0.0004	0.0002	0.0004	0.0006
Chromium	Cr	mg/L	0.1	<0.005	0.002	<0.004	<0.004	0.003	0.004	0.002	0.002	<0.002	0.0006
Cobalt	Co	mg/L	0.0006 *	0.0002	<0.005	<0.01	0.012	<0.005	<0.005	<0.005	<0.005	<0.005	<0 001
Copper	Cu	mg/L	0 005	0.0057	0.03	0.007	0.009	0.02	0.02	0.02	0.023	0.04	0.0011
Nickle	Ni	mg/L	0.025	0.003	0.034	<0.01	0.014	0.007	0 006	0.008	0.015	0 005	0.014
Lead	Pb	mg/L	0.025	<0.0005	0.17	<0.02	0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	Zn	mg/L	0.03	0.014	0.09	0.12	0.14	0.21	0.08	0.05	0.12	0.03	0 0505
Silver	Ag	mg/L	0.0001	<0.00005	0.003	<0.01	<0.001	<0.01	<0.001	<0.01	<0.03	<0.001	<0 004
Molybdenum	Mo	mg/L	0.01	0.004	<0.01	<0.01	<0.005	<0 01	<0.01	<0.01	<0.01	0.011	<0 004
Vanadium	V	mg/L	0.007 *	0.0009	0.015	<0.005	0.005	<0.005	<0.005	<0.005	0.005	<0.005	0.0013
Iron	Fe	mg/L	0.3	0.24	1.76	0.9	0.69	0.57	0.58	0.46	1.37	0.58	1.01
Manganese	Mn	mg/L		0.094	0.18	0.14	0.12	0.06	0.05	0.08	0.07	0.12	0.119
Strontium	Sr	mg/L		1.58	1.8	1.8	2.08	1.57	1.58	1.95	1.32	1.68	1.67
Barium	Ba	mg/L		0.057	0.08	0.071	0.31	0.07	0.06	0.07	0.07	0.04	0.059
Boron	B	mg/L	0.2	0.174	0.16	0.15	0.18	0.13	0.14	0.15	0.075	0.14	0.13

PWQO - Provincial Water Quality Objectives (July 1994): PWQO for alumimum if for filtered sample
* - Interim PWQO currently under development

Appendix C: Surface Water Quality Data
Closed Brampton Street Landfill Site

Analytical Parameter			PWQO	Surface Water Monitoring Station SW-2							
				30-May-96	12-Jul-96	21-Aug-96	23-Oct-96	21-Nov-96	12-Mar-97	16-Apr-97	07-Jul-97
General Parameters											
pH (Field)			6.5-8.5	8.4	7.8	7.01	8.2				
Temperature (Field)		°C		15.5	19.8	22.8	10.7				
Disolved Oxygen (Field)	DO	mg/L		15	9	4.3	10				
Conductivity (Field)		us/cm		1568	1492	1437	1125				
pH (Lab)			6.5-8.5	8.39							
Conductivity (lab)		umhos.cm									
Total Suspended Solid	TSS	mg/L		10.5	17.5	14.4	8.2	3	5	8.4	16.6
Total Dissolved Solid	TDS	mg/L			832	906					
Alkalinity		mg/L		183.2	192	75.4	234	224	206	178	125
Sodium	Na	mg/L		140	139	134	88.3	117	185	173	99
Calcium	Ca	mg/L		120	118	103	118	128	129	108	71.2
Magnesium	Mg	mg/L		39.2	35.5	33.1	29.8	39.7	32.7	36	21.8
Potassium	K	mg/L		6	5.8	6.6	5.8	5.3	5.1	5.1	4.8
Chloride	CL	mg/L		235	255	240	141	215	328	312	183
Sulphate	SO4	mg/L		219	205	255	215	27	166	206	150
Nitrate	NO3	mg/L		1.5	1.45	0.724	2.58	1.28	2.21	1.25	1.12
Nitrite	NO2	mg/L		<0.2	0.061	0.062	0.048	0.024	0.017	0 019	0.054
Ammonia	NH3-N	mg/L			0.2	0.4	0 1	0.2	0.2	0.2	0.5
Total Kjeldahl Nitrogen	TKN	mg/L		0.78	1	0.6	0.8	1 4	0.8	0.8	<0.6
Unionized NH3	Free NH3	mg/L	0.02		0.0048	0.0020	0.0030				
Ortho Phosphorus	PO4	mg/L		<1		0.073				<0.024	
Total Phosphorus	P	mg/L	0.01	0.056	0.047	0.096	0.128	0.054	<0 024	<0.024	0.077
Phenols		mg/L	0.001	<0.0005	0.008	<0.002	<0.002	<0.002	<0.002	<0.003	0 006
Chemical Oxygen Demand	COD	mg/L		15	18	20	16	30	13	17	44
Biological Oxygen Demand	BOD	mg/L		1.6	9	8	<4	12	<4	<4	15
Dissolved Organic Carbon	DOC	mg/L		2.9	4.8	3.6	4.6	3.5	6.2	3.6	5.2
Trace Metals											
Aluminum	Al	mg/L	0.075	0.165	0.011	0.017	<0.01	<0.01	<0.01	<0.01	0.05
Beryllium	Be	mg/L	1 1	<0.001	<0.01	<0.001	<0.01	<0 01	<0.01	<0 01	0.0001
Cadmium	Cd	mg/L	0.0002	<0.0001	0.0007	0.0002	0.0001	0.0004	0.0003	0.0003	0.0006
Chromium	Cr	mg/L	0 1	<0.005	<0 002	<0.005	0.004	<0.002	0.002	<0 002	0.0006
Cobalt	Co	mg/L	0.0006 *	0.0002	<0.005	0.01	<0.005	<0.005	<0 005	<0.005	<0.001
Copper	Cu	mg/L	0 005	0.0088	0 04	0.019	0.02	0.04	0.034	0 026	0 0006
Nickle	Ni	mg/L	0.025	0.003	0.021	0.016	0.005	0 005	0 031	<0.005	0 007
Lead	Pb	mg/L	0 025	0 0013	0 12	0 019	<0.005	<0 005	<0 005	<0 005	<0 005
Zinc	Zn	mg/L	0 03	0 02	0.11	0 08	0 14	0.06	0 15	0.05	0 0404
Silver	Ag	mg/L	0.0001	<0.00005	0.003	<0 001	<0.001	<0 001	<0.03	<0.001	<0.004
Molybdenum	Mo	mg/L	0 01	0.004	<0 01	<0 006	<0 01	<0.01	<0.01	<0 01	<0 004
Vanadium	V	mg/L	0.007 *	0.0021	0.008	<0.005	<0 005	<0.005	<0.005	<0.005	0 0008
Iron	Fe	mg/L	0.3	0.34	0 6	0.62	0.57	0.16	0.5	0 16	0 747
Manganese	Mn	mg/L		0.085	0.15	0.13	0.05	0.07	0.07	0.09	0.0979
Strontium	Sr	mg/L		1.63	1.81	1.98	1.61	2.02	1.69	1.73	1.25
Barium	Ba	mg/L		0.057	0.07	0.2	0.06	0.08	0.07	0.06	0.047
Boron	B	mg/L	0.2	0.171	0.16	0.17	0.13	0.15	0.089	0.14	0.12

PWQO - Provincial Water Quality Objectives (July 1994): PWQO for alumimum if for filtered sample
* - Interim PWQO currently under development

Appendix C: Surface Water Quality Data
Closed Brampton Street Landfill Site

Analytical Parameter			PWQO	Surface Water Monitoring Station SW-1								
				30-May-96	12-Jul-96	21-Aug-96	23-Oct-96	23-Oct-96 Field Dupl.	21-Nov-96	12-Mar-97	16-Apr-97	07-Jul-97
General Parameters												
pH (Field)			6.5-8.5	8.4	7.8	7.21	8.2					
Temperature (Field)		°C		14.2	19.5	23.3	10.9					
Disolved Oxygen (Field)	DO	mg/L		12	11	7.3	10					
Conductivity (Field)		us/cm		1305	1453	1376	1132					
pH (Lab)			6.5-8.5	8.28								
Conductivity (lab)		umhos.cm										
Total Suspended Solid	TSS	mg/L		2.5	14.5	8.4	8	10	2.2	12.6	5	9
Total Dissolved Solid	TDS	mg/L			876	826						
Alkalinity		mg/L		189.8	203	81.2	226	222	229	186	191	136
Sodium	Na	mg/L		133	132	114	80.2	83.6	103	159	163	89
Calcium	Ca	mg/L		122	125	106	113	114	199	114	114	78.2
Magnesium	Mg	mg/L		39.6	36.2	35.1	30.9	29.5	34.4	28	37.7	21.8
Potassium	K	mg/L		5	6.5	6.9	5.7	5.9	4.8	4.8	5	4.6
Chloride	CL	mg/L		230	228	218	139	139	206	298	297	163
Sulphate	SO4	mg/L		222	219	234	217	213	24	150	206	145
Nitrate	NO3	mg/L		1.5	1.5	0.957	2.92	2.58	1.3	2.44	1.3	0.902
Nitrite	NO2	mg/L		<0.2	0.042	0.049	0.038	0.039	0.024	0.031	0.021	0.035
Ammonia	NH3-N	mg/L			0.1	0.3	0.1	0.2	0.2	0.2	0.2	0.3
Total Kjeldahl Nitrogen	TKN	mg/L		0.67	1.1	0.9	1	0.9	2	1	0.8	<0.6
Unionized NH3	Free NH3	mg/L	0.02		0.00235	0.00243	0.0031					
Ortho Phosphorus	PO4	mg/L		<1		0.03					<0.024	
Total Phosphorus	P	mg/L	0.01	0.037	0.035	0.067	0.113	0.134	0.051	0.097	<0.024	0.038
Phenols		mg/L	0.001	<0.0005	0.008	<0.002	<0.002	<	<0.002	<0.002	<0.003	<0.003
Chemical Oxygen Demand	COD	mg/L		14	21	85	19	16	23	11	18	31
Biological Oxygen Demand	BOD	mg/L		1.6	12	7	<4	<	<6	<4	<4	14
Dissolved Organic Carbon	DOC	mg/L		3	3.7	3.9	5.4	4.3	3.5	6.6	3.3	4.9
Trace Metals												
Aluminum	Al	mg/L	0.075	0.116	0.02	0.017	<0.01	0.02	<0.01	0.095	<0.01	<0.05
Beryllium	Be	mg/L	1.1	<0.001	<0.01	<0.001	<0.01	<	<0.01	<0.01	<0.01	0.0001
Cadmium	Cd	mg/L	0.0002	0.0001	0.0009	0.0002	0.0002	0.0002	0.0001	0.0002	0.0002	0.0006
Chromium	Cr	mg/L	0.1	<0.005	<0.002	<0.005	0.002	0.004	0.002	0.002	<0.002	0.0006
Cobalt	Co	mg/L	0.0006 *	0.0002	<0.005	0.011	<0.005	<	<0.005	<0.005	<0.005	<0.001
Copper	Cu	mg/L	0.005	0.0087	0.05	0.016	0.03	0.02	0.04	0.047	0.018	0.0006
Nickle	Ni	mg/L	0.025	0.003	0.025	0.013	<0.005	0.006	0.006	0.025	<0.005	0.012
Lead	Pb	mg/L	0.025	0.0009	0.19	0.029	<0.005	<	<0.005	<0.005	<0.005	<0.005
Zinc	Zn	mg/L	0.03	0.018	0.09	0.08	0.07	0.08	0.09	0.13	0.05	0.0335
Silver	Ag	mg/L	0.0001	<0.00005	0.004	<0.001	<0.001	<	<0.001	<0.03	<0.001	<0.004
Molybdenum	Mo	mg/L	0.01	0.004	0.01	<0.006	<0.01	<	<0.01	<0.01	<0.01	<0.004
Vanadium	V	mg/L	0.007 *	0.0006	0.007	<0.005	<0.005	<	<0.005	0.006	<0.005	0.0006
Iron	Fe	mg/L	0.3	0.2	0.26	0.09	0.46	0.58	0.15	1.17	0.11	0.323
Manganese	Mn	mg/L		0.074	0.1	0.09	0.04	0.05	0.07	0.07	0.1	0.0609
Strontium	Sr	mg/L		1.66	1.84	2.11	1.52	1.58	1.86	1.44	1.76	1.25
Barium	Ba	mg/L		0.056	0.06	0.23	0.07	0.06	0.06	0.08	0.07	0.042
Boron	B	mg/L	0.2	0.173	0.16	0.18	0.12	0.14	0.15	0.083	0.14	0.13

PWQO - Provincial Water Quality Objectives (July 1994): PWQO for alumimum if for filtered sample
* - Interim PWQO currently under development

Appendix D

Combustible Gas Monitoring Data

Appendix D: Closed Brampton Street Landfill Gas Monitoring Results

Monitor	Date			02 (% Volume)	Combustible Gas (% LEL)	H2S (ppm)	CO (ppm)
G1	96-06-21			17.5	264	0	3
	96-07-09			18	24	0	1
	96-07-26			6.9	74	0	3
	96-08-20			5.5	40	0	3
	96-09-13			1.9	126	0	198
	96-10-21			1.9	148	2	135
	97-01-31			2	117	1	60
	97-02-07			4.3	0	2	91
	97-02-11			3.6	0	0	101
	97-02-14			5.5	1	1	81
	97-02-18			2.5	1	2	49
	97-02-27			3	162	0	144
	97-03-10			7.1	208	1	220
	97-04-02			3.5	197	1	736
	97-04-15			2.8	147	1	535
	98-01-16			4.9	414	2	742
	98-01-30			6	417	2	167
	98-02-10			6.6	136	1	150
	98-02-26			0	128	2	75
	98-03-12*			2.4	458	3	813
	98-03-26			3.9	485	1	33
	98-04-07**			--	--	--	--
	98-07-22			--	--	--	--
	98-08-18			Alarm	Alarm	0	0
	98-09-23			2	79	0	14
	98-10-05			1	52	0	11
	98-11-04			0.1	40	0	3
	98-11-19			5	45	0	192
	98-12-08			0.4	37	0	8
G2	96-06-21			1.8	252	0	61
	96-07-09			0.03	147	0	225
	96-07-26			5.3	157	0	275
	96-08-20			10.3	152	0	297
	96-09-13			0.8	>100	0	>400
	96-10-21			8.7	143	0	476
	97-01-31			11.4	134	1	707
	97-02-07			6.1	0	2	132
	97-02-11			6.3	0	0	142
	97-02-14			3.2	1	1	7
	97-02-18			3.9	0	2	120
	97-02-27			19.3	1	1	3
	97-03-10			20.3	0	0	0
	97-04-02			20.5	0	1	1
	97-04-15			11.7	217	1	922
	98-01-16			0.7	186	65	188
	98-01-30			17.3	0	1	0
	98-02-10			17.1	0	1	0
	98-02-26			19	5	1	0
	98-03-12*			20.1	1	2	3
	98-03-26			19.3	0	0	0
	98-04-08			11.6	1	11	9
	98-04-20			18.3	0	0	0
	98-05-07			19.4	0	0	0
	98-05-21			20.7	0	0	0
	98-07-22			Alarm	Alarm	0	Alarm
	98-08-18			Alarm	Alarm	0	0
	98-09-23			17.5	82	0	0
	98-10-05			14.4	265	0	0
	98-11-04			15.3	294	0	270
	98-11-19			13.4	64	0	690
	98-12-08			19.1	77	0	0

Appendix D: Closed Brampton Street Landfill Gas Monitoring Results

Monitor	Date			02 (% Volume)	Combustible Gas (% LEL)	H2S (ppm)	CO (ppm)
G5	96-06-21			20.3	0	0	0
	96-07-09			20	0	0	1
	96-07-26			20.1	0	0	0
	96-08-20			19.8	0	0	0
	96-09-13			-	-	-	-
	96-10-21			20.7	0	0	0
	97-01-31			18	1	1	0
	97-02-07			18.4	0	0	1
	97-02-11			14.5	0	0	0
	97-02-14			15.1	1	0	0
	97-02-18			11.1	1	0	0
	97-02-27			19.3	1	1	3
	97-03-10			21	0	0	0
	97-04-02			20.8	0	1	1
	97-04-15			20.5	0	1	0
	98-01-16			21 2	0	0	0
	98-01-30			20 4	0	0	0
	98-02-10			20 3	0	0	0
	98-02-26			20 9	0	0	0
	98-03-12*			20 7	0	0	0
	98-03-26			20 6	0	0	0
	98-04-07			20.7	0	0	0
	98-04-20			20 6	0	1	0
	98-05-07			20 8	0	0	0
	98-05-21			20 9	0	0	1
	98-07-22			20 3	0	0	0
	98-08-18			20 9	0	0	0
	98-09-23			20 5	0	0	0
	98-10-05			20 6	0	0	0
	98-11-04			20.9	0	0	0
	98-11-19			20 8	0	0	0
	98-12-08			20 8	0	0	0
G6	96-06-21			-	-	-	-
	96-07-09			1.5	0	0	0
	96-07-26			12.3	0	0	0
	96-08-20			12.3	0	0	0
	96-09-13			-	-	-	-
	96-10-21			-	-	-	-
	97-01-31			-	-	-	-
	97-02-07			-	-	-	-
	97-02-11			-	-	-	-
	97-02-14			-	-	-	-
	97-02-18			-	-	-	-
	97-02-27			-	-	-	-
	97-03-10			-	-	-	-
	97-04-02			-	-	-	-
	97-04-15			-	-	-	-
	98-01-16			--	--	--	--
	98-01-30			--	--	--	--
	98-02-10			--	--	--	--
	98-02-26			20 8	0	0	0
	98-03-12*			15	3	3	3
	98-03-26			8 8	2	0	0
	98-04-08			--	--	--	--
	98-04-20			2.8	42	0	24
	98-05-07			alarm	alarm	1	10
	98-05-21			alarm	alarm	3	1
	98-07-22			--	--	--	--
	98-08-18			--	--	--	--
	98-09-23			8 2	0	0	0
	98-10-05			8 5	0	0	0
	98-11-04			8 1	0	0	0
	98-11-19			11 2	2	0	0
	98-12-08			9 6	0	0	0

Appendix D: Closed Brampton Street Landfill Gas Monitoring Results

Monitor	Date			02 (% Volume)	Combustible Gas (% LEL)	H2S (ppm)	CO (ppm)
MH2	96-06-21			20.8	0	0	0
	96-07-09			20.5	0	0	0
	96-07-26			20.6	0	0	0
	96-08-20			20.2	0	0	1
	96-09-13			-	-	-	-
	96-10-21			20.5	0	0	1
	97-01-31			20.8	0	1	2
	97-02-07			20.4	0	0	0
	97-02-11			20.5	0	0	0
	97-02-14			20.5	0	0	0
	97-02-18			21	0	0	0
	97-02-27			20.7	1	0	0
	97-03-07			21.1	0	0	0
	97-04-02			19.9	0	0	1
	97-04-15			20.5	1	1	0
	98-01-16			21 2	0	1	0
	98-01-30			18 2	3	1	2
	98-02-10			20 7	0	0	2
	98-02-26			20.7	0	1	0
	98-03-12*			20 7	1	1	2
	98-03-26			20 2	0	0	0
	98-04-07			20 4	0	0	0
	98-04-20			19 6	0	1	1
	98-05-07			20 9	0	0	0
	98-05-21			20	0	0	1
	98-07-22			--	--	--	--
	98-08-18			20 2	0	0	0
	98-09-23			20 8	0	0	0
	98-10-05			20 7	0	0	0
	98-11-04			20.5	0	0	0
	98-11-19			20 8	0	0	0
	98-12-08			20 9+	0	0	0
MH3	96-06-21			20.7	0	0	0
	96-07-09			20.5	0	0	0
	96-07-26			20.6	0	0	0
	96-08-20			20.2	0	0	1
	96-09-13			-	-	-	-
	96-10-21			20.5	0	0	1
	97-01-31			21	0	0	0
	97-02-07			20.6	0	0	0
	97-02-11			20.9	0	0	0
	97-02-14			20.7	0	0	0
	97-02-18			21	0	0	0
	97-02-27			20.7	1	0	0
	97-03-07			21.2	0	1	0
	97-04-02			20.9	0	0	0
	97-04-15			20.7	0	0	0
	98-01-16			21	0	0	0
	98-01-30			18 2	5	1	2
	98-02-10			20 7	0	1	3
	98-02-26			20 6	0	0	0
	98-03-12*			20 6	1	1	5
	98-03-26			20 4	0	0	0
	98-04-07			20 8	0	0	0
	98-04-20			19 7	0	0	1
	98-05-07			20 8	0	0	0
	98-05-21			20 8	0	0	1
	98-07-22			20 5	0	0	0
	98-08-18			20 4	0	0	0
	98-09-23			20 5	0	0	0
	98-10-05			20 8	0	0	0
	98-11-04			20 6	0	0	0
	98-11-19			20 7	0	0	0
	98-12-08			20 7	0	0	0

Appendix D: Closed Brampton Street Landfill Gas Monitoring Results

Monitor	Date			02 (% Volume)	Combustible Gas (% LEL)	H2S (ppm)	CO (ppm)
SS1	96-06-21			20.8	0	0	0
	96-07-09			20.8	0	0	0
	96-07-26			21	0	0	0
	96-08-20			20.4	0	0	0
	96-09-13			-	-	-	-
	96-10-21			20.8	0	0	0
	97-01-31			20.8	0	0	0
	97-02-07			20.6	0	0	0
	97-02-11			20.9	0	0	0
	97-02-14			20.9	0	0	0
	97-02-18			21	0	0	0
	97-02-27			20.8	0	0	0
	97-03-07			-	-	-	-
	97-04-02			20.9	0	0	0
	97-04-15			20.7	0	0	0
	98-01-16			--	--	--	--
	98-01-30			20.8	0	0	0
	98-02-10			20 9	0	0	0
	98-02-26			20.7	0	0	0
	98-03-12*			20 8	0	0	0
	98-03-26			--	--	--	--
	98-04-07			20 9	0	0	0
	98-04-20			20.8	0	0	0
	98-05-07			20.8	0	0	0
	98-05-21			21	0	0	1
	98-07-22			20 5	0	0	0
	98-08-18			21	0	0	0
	98-09-23			20 9	0	0	0
	98-10-05			20 9	0	0	0
	98-11-04			20 9	0	0	0
	98-11-19			20.9	0	0	0
	98-12-08			20 9	0	0	0
SS2	96-06-12			20.6	0	0	0
	96-06-21			20.8	0	0	1
	96-07-09			20.8	0	0	0
	96-07-26			21	0	0	0
	96-08-20			20.5	0	0	0
	96-09-13			-	-	-	-
	96-10-21			20.8	0	0	0
	97-01-31			-	-	-	-
	97-02-07			20.9	0	0	0
	97-02-11			20.9	0	0	0
	97-02-14			20.9	0	0	0
	97-02-18			21	0	0	0
	97-02-27			20.8	0	0	0
	97-03-07			21 3	0	0	0
	97-04-02			20.9	0	0	0
	97-04-15			20.8	0	0	0
	98-01-16			--	--	--	--
	98-01-30			20 8	0	0	0
	98-02-10			20 9	0	0	0
	98-02-26			20 7	0	0	0
	98-03-12*			21	0	0	0
	98-03-26			20 8	0	0	0
	98-04-07			20 8	0	0	0
	98-04-20			20.8	0	0	0
	98-05-07			20 8	0	0	0
	98-05-21			21	0	0	1
	98-07-22			20 6	0	0	0
	98-08-18			20 9	0	0	0
	98-09-23			20 9	0	0	0
	98-10-05			20.9	0	0	0
	98-11-04			20 9	0	0	0
	98-11-19			20 9	0	0	0
	98-12-08			20 9	0	0	0

Appendix E

Meteorological Data and Water Budget

LONG TERM WATER BUDGET FOR BRAMPTON STREET LANDFILL SITE

MONTH	MEAN TEMPERATURE C	TOTAL PRECIPITATION mm	ACTUAL EVAPOTRANSPIRATION mm	ACTUAL WATER BALANCE mm
January	−4.0	58	0	58
February	−3.4	55	0	55
March	1.2	69	4	65
April	7.4	68	34	34
May	13.1	70	75	−5
June	18.9	81	110	−29
July	22.4	60	99	−39
August	21.5	83	93	−10
September	17.4	87	87	0
October	10.9	59	45	14
November	5.3	75	16	58
December	−0.8	83	0	83
Year Total		848	564	284

Notes:
- 1967 to 1990 meteorological data from Hamilton Municipal Laboratory Meteorological Station were used to prepare this long term water budget
- The Thornthwaite C.W.,, and J. R. Mather method (1957) was used to calculate the actual water balance, assuming soil moisture storage of 100 mm.

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Annual Meteorological Summary/Sommaire Météorologique Annuel

For / Pour Hamilton (YHM) *Year / Année: 1998*

Meteorological Data for the Year / Donnees Météorologiques Pour L'année

Daily Total Precipitation / précipitations totales quotidiennes

	Jan janv	Feb févr	Mar mars	Apr avr	May mai	Jun juin	Jul juill	Aug aout	Sep sept	Oct oct	Nov nov	Dec dec
1	TR		6.3	3.4	0.2					TR		1.0
2			0.4	6.2	1.6	2.4			0.8	TR		
3	5.5	TR	1.2	TR	3.0	TR			0.2			TR
4	8.9		1.4		TR		24.2					
5	10.0		0.4		TR	TR		TR				3.0
6	3.2		0.2				3.6	4.6	TR		TR	2.4
7	19.5		TR			TR	12.4	0.7	8.0	17.7	TR	
8	14.8		19.4	1.4	0.6		25.8		0.5	0.4	TR	TR
9	7.7		13.0	TR	TR		17.2		TR		0.6	
10	0.8		2.5		17.0	TR		1.2			16.6	
11	0.2	1.5			8.7	6.4		4.0			1.3	
12		2.2	2.4		0.3	6.8			TR		TR	
13	1.8	TR	3.0			4.0						
14	0.2	TR	6.4	15.1						1.4	TR	
15	10.4		TR	TR			1.4	0.4	0.2		TR	
16	TR	TR		20.0		2.7	14.5		0.2		6.0	0.5
17	1.0	25.8	TR	2.2		4.9	7.8			TR	1.0	1.0
18	0.5	5.6	11.4		TR			2.6		1.0		TR
19	TR	2.6	13.4	16.8	0.4		TR				TR	6.2
20	TR	0.7	5.0	1.2						0.2	TR	TR
21			27.7				TR			1.8	TR	14.6
22	0.8	TR	3.0			TR	1.0	4.0	0.8			3.2
23	12.0					1.1	0.4					
24	TR				0.8			TR			TR	
25	TR		TR		0.8	0.5		TR			2.8	
26	1.8		TR	TR					TR		6.4	TR
27	TR	1.2	TR						2.0			
28		2.0	11.0			1.0		TR		0.4		
29	4.6				TR			1.2	2.2		TR	1.8
30	TR			-		26.0	0.4		5.2		4.2	TR
31					3.4							TR

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